National ICT R&D Fund
Policy Framework

Ministry of Information Technology
IT & Telecom Division
Government of Pakistan

June 10, 2006

List of Abbreviations and Acronyms

ICT	Information & Communication Technology
R&D	Research and Development
MINFAL	Ministry of Food Agriculture and Livestock
NFC	National Fertilizer Corporation
EGD	Electronic Government Directorate
NTC	National Telecommunication Corporation
PCB	Pakistan Computer Bureau
PSEB	Pakistan Software Export Board
VU	Virtual University
IT	Information Technology
PTCL	Pakistan Telecommunication Company Ltd
IRPA	Intensification of Research in Priority Areas
SERC	Science and Engineering Research Council
EAR	Experimental Applied Research
PR	Prioritized Research
SR	Strategic Research
SME	Small and Medium Enterprise
MBO	Management by Objectives
PARC	Pakistan Agricultural Research Council
PCRWR	Pakistan Council for Research and Water Resources
PCCC	Pakistan Central Cotton Committee
PCSIR	Pakistan Council for Scientific and Industrial Research
GIS	Geographic Information Systems
HRD	Human Resource Development
BPO	Business Process Outsourcing
HEC	Higher Education commission
RFP	Request For Proposals
LTD	Live Test & Demonstration
OCD	Operational Capability Demonstration
PI	Principal Investigator
PMC	Project Management Committee
LAFS	Legal, Administrative and Financial Structure

Table of Contents

List of Charts & Figures

PREAMBLE

Nations worldwide have recognized developmental opportunities and challenges of the emerging information age characterized by Information and Communication Technologies (ICT). These technologies are driving national development efforts worldwide and a number of countries in both developing and the developed world are exploring ways of facilitating their development process through development, deployment and the exploitation of ICT within their economies and societies.

In both the developed and developing nations, the driving force behind the development of high-tech industries and services has been huge investments in R&D efforts. Various studies have established a link between economic development and the level of investments in R&D as well as in basic and applied, scientific and industrial research. It is acknowledged that Pakistan's Research and Development (R&D) capacity is limited and evidence shows that very little R&D work is being undertaken in industry and in the nation's universities and research institutions. Most of these institutions lack the necessary capacity to conduct and engage in the advanced and cutting edge R&D activities required for supporting the development of a globally competitive information, knowledge-based and high tech industry. Also the required linkages between industry and the research institutions, that is necessary to commercially drive R&D work and its outputs are virtually non-existent in Pakistan.

The Government is committed to promoting and supporting R&D initiatives to enhance Pakistan's capacity to develop and produce ICT products as well as services as a step towards developing a globally competitive ICT sector and industry. This R&D Fund is a part of the commitment to meet the R&D needs for sustaining the current growth in the ICT sector of Pakistan. The Fund would be the first independently managed organization that would play an instrumental role in the enhancement of research and development culture in Pakistan.

The Research and Development Fund Policy Framework sets out a road map for the development of Pakistan's ICT industry. The development of this policy framework was based on a nation wide consultative process involving all key stakeholders in public and private sector and from both industry and academia. The need for Pakistan to develop a regional competitive advantage in the area of ICT exploitation and production through the development of a competitive ICT industry is widely recognized. Making ICT sector, a highly competitive value-added sector has been identified as a key to transforming Pakistan's economy into a high-income economy with the potential to create wealth and quality jobs.

The R&D Fund Policy will create an ICT dominated culture by focusing the following dimensions.

- ICT as an Enabler for
    - Industrial demand driven human resource development
    - Economic Development
    - Social Development
    - Knowledge Driven Industrial development
    - Education Development
    - Poverty Alleviation
    - Job Creation
    - Government Administration
    - Service Delivery
    - Multi-Sectoral Support
- ICT as a Facilitator for
    - E-Government Initiatives
    - E-Commerce Initiatives
    - Service Sector Growth
    - Private Sector Development

The policy is aimed at addressing a number of developmental challenges facing the country as a basis for achieving a number of policy goals and objectives. The framework reflects the government's total commitment to transform Pakistan into an information-rich, knowledge based economy and former driven society through synergic development of industrial and academic resources, to ensure that Pakistan and its people fully participate in the information age and enjoy social, cultural and economic benefits of the emerging information revolution.

CHAPTER ONE
R&D FUND POLICY VISION & OBJECTIVES

1.1 The Vision

To transform Pakistan's economy into a knowledge based economy by promoting efficient, sustainable and effective ICT initiatives through synergic development of industrial and academic resources.

The emerging information and knowledge age and the new technological revolution are heralding a new economic and social order characterized by the development and exploitation of ICT within all spheres of human endeavor. This era is giving rise to the emergence of information and knowledge based economies with traditional economic, industrial and commercial activities moving towards knowledge driven processes.

Developing countries are recognizing the need to rapidly develop their knowledge base through massive investments in human resource development. Also, the need to invest in Research and Development efforts to create new products and services; as a way of gaining competitive advantage in an increasingly competitive global economic environment has been given a priority by most nations as part of their efforts to develop their information economy and society. It is also being stressed in the policies of world-wide research activities that research should be commercially driven through its linkages with the industry. Collaborative efforts between academia, research institutions and industry are being emphasized to ensure that local economy can reap the monetary benefits of investment in research.

The knowledge and information economy has emerged as a new source for the creation of quality jobs, wealth generation and redistribution, rapid economic development and prosperity as well as a means for facilitating competitiveness. With the emerging information age, ICTs are seen by a number of countries as critical for achieving progress in economic and social development. These technologies are offering developing countries like Pakistan a window of opportunity to leap-frog the key stages of industrialization and transform their agriculture dominated economies into service-sector driven, high value-added information and knowledge economies that can successfully compete in the international market.

A number of countries in both the developed and developing world have in place relevant policies and strategic plans that will enable them to transform their economies into information and knowledge-based economies (IKEs). Pakistan like other developing countries is equally placed to take advantage of information and to facilitate her socio-economic development to aid the process of transforming the nation's economy into information-rich and knowledge based economy and society.

1.2 Broad Policy Objectives

To realize the key aspirations of R&D Fund Policy Vision, the following goals shall be pursued:

- Provide an enabling environment that facilitates deployment, exploitation and utilization of ICT for enhanced national productivity

- Enhance the national ICT related human resource development capacity manifolds by facilitating industrial demand focused human resource capacity building and R&D capabilities in the country and promoting ICT related educational programs and activities

- Help develop a knowledge based ICT industry for delivery of value-added ICT products and services

- Facilitate the development of comparative advantage in the ICT industry

- Make Pakistan an attractive destination for service oriented and research and development related outsourced jobs

- Enhance use of ICT in nationally important segments of economy like agriculture

- Promote indigenous development in Telecom Sector that would support ICT

- Contribute towards the growth of other sectors of economy through deployment of superior ICT products and services

- Cultivate Industry-Academia Partnership

- Provide support to national information and communication infrastructure through indigenous development of ICT products and services

- Spread the ICT activities on a true National Level

- Help develop standards, practices, guidelines and models for the sustainable promotion and growth of ICT

- Use ICT as a tool for poverty alleviation and upward mobility for economically challenged groups of citizens

- Facilitate research and development in those sections of ICT that enhance quality of life for citizens.

CHAPTER TWO
POLICY BACKGROUND

This section traces the backdrop of the R&D fund vision and objectives by drawing comparative analysis of the historical initiatives taken in the filed, the related international best practices and the lessons learnt from all such exercises. This analysis is expected to enable the stakeholders to understand the basic motivation, premise and challenges behind formulating an effective R&D policy for the ICT sector of the country. The following sub-sections briefly address the historical perspective of public-sector backed R&D efforts in the country, the current scenario, the growth of ICT sector and future outlook. The idea is to establish the rationale for the policy document that could then be translated into strategic measures to ensure a practical and result oriented implementation.

2.1 Historical Perspective

Despite the fact that scores of research activities have been initiated by government agencies, the research and development carried through them has not borne the desired results. After the creation of Pakistan, the initial efforts for starting indigenous research lacked a future perspective. They were planned only to meet the momentary needs. The result is that many of them do not have any effective functioning today. They have been inflexible to change and late in adapting new technologies, mainly because continuous evaluation and improvement has not been a part of their mandate.

The government departments which have created a large number of research bodies include Ministry of Food Agriculture and Livestock (MINFAL), Ministry of Industries Production and Special Initiatives, Ministry of Science and Technology, Ministry of Information Technology and Telecom, Ministry of Environment and Higher Education Commission. Some of their projects are in the form of autonomous bodies working under the umbrella of the respective ministries while others were created as attached departments.

2.1.1 R&D Initiatives in Food and Agriculture:

The projects initiated by MINFAL have had diverse objectives including improving and developing the growing techniques and marketing of cotton, locust survey and control, agricultural commodities research, marketing intelligence services related to agricultural and livestock commodities, maintaining liaison with the international marketing organizations and management and development of fishery resources in the interest of the nation. The achievements against these objectives are relatively humble. There is unnecessary duplication of resources in agricultural research. There are many physical research centers established with similar objectives, however only one or two of them have substantial achievements to their credit.

2.1.2 R&D for Industrial Development:

The Ministry of Industries, Production and Special Initiatives has created National Productivity Organization, Engineering Development Board, Pakistan Industrial Technical Assistance Centre, National Fertilizer Corporation (NFC) to meet its R&D needs. The main objectives of these bodies have been enhancement of national productivity, increasing international competitiveness of engineering industry, training of the skills of industrial personnel, development of industrial infrastructure and up-gradation of industrial technologies.

2.1.3 R&D for Scientific and Technological Development:

The major objectives of various research councils and institutes established by the Ministry of Science and Technology are to conduct R&D work on problems faced by the industrial sector; goal oriented research in the areas of molecular biology; to provide better health to citizens through research in areas of water management, and quality of water resources; to maintain linkages through seminars, workshops, publications; to undertake cooperative research with local and foreign R&D organizations and commerce-industrial outfits on projects of national interest; to establish comprehensive scientific and technological information dissemination centers and promote basic and fundamental research in the universities and other institutions.

2.1.4 R&D for Development of IT and Telecom Sector:

The R&D departments of the ministry of IT and Telecom include Electronic Government Directorate (EGD), National Telecommunication Corporation (NTC), Pakistan Computer Bureau (PCB), Pakistan Software Export Board (PSEB) and Virtual University (VU)). The objectives of these bodies are to provide quality IT training in Government Departments and to lend support to the Ministry of IT in the implementation of IT policy initiatives; to provide basic telecommunication services to Federal and Provincial Governments, their departments and autonomous organizations; imparting IT education through T.V. and the Internet; planning and implementing e-government projects; sustaining the momentum of growth in the IT and IT enabled Services industry. In addition to these efforts by various government agencies, an R&D Fund was created within Pakistan Telecommunication Company Ltd (PTCL) to support various projects and initiatives in the field of IT and Telecommunications. Contribution to the Fund has, however, been made only by PTCL, and therefore scope of its activities has also been restricted.

2.2 International Best Practices

The important role that industrial and scientific research as well as Research and Development can play in developing a nation's capacity and capabilities to develop advanced products and services has been acknowledged. For most countries, investments in R&D have been identified as a precondition for a sustained socio-economic development.

In both the developed and developing nations, the driving force behind the development of high-tech industries and services has been huge investments in R&D efforts. In fact, various studies have established a link between economic development and the level of investment in R&D as well as basic and applied scientific and industrial research. For example, evidence drawn from a number of countries, has established strong link between the number of scientists and engineers involved in R&D(per million persons) and the high tech exports (in millions of dollars) of countries.

Keeping these international trends in view, the R&D Fund Policy has been built upon experiences of major research and development activities of advanced economies. The following international models are the prominent ones amongst many that have been consulted for developing the various policy recommendations that fit in the context of Pakistan.

Case 1: Malaysia - Intensification of Research in Priority Areas (IRPA) program
Case 2: Singapore - Science and Engineering Research Council (SERC) R&D funding
Case 3: Korea - The Highly Advanced National (Han) Projects
Case 4: Hungary- Research and Technology Innovation Fund
Case 5: Finland – Tekes R&D Grant to companies

Case 1: Malaysia - Intensification of Research in Priority Areas (IRPA) Program

The purpose of the Intensification of Research in Priority Areas (IRPA) program is to focus R&D activities in areas which have potential for enhancing the national socio-economic position. Priority is given to those projects which have commercialization potential and which address the needs of local industry. Collaborative efforts among research institutions are encouraged under this program. Enhancing public and private sector linkages in R&D for improving country's socio-economic environment is on the agenda of this program.

Research Categories

The IRPA program is divided into 3 types of research categories:

i. **Experimental Applied Research (EAR) –** Projects in this category should be towards generating institutional capacity & knowledge advancement. Projects must possess commercialization potential and could involve more than one institution.
The priority areas in Experimental Applied Research include Agriculture and Food Security, Natural Resources and environment, Manufacturing & Services, Knowledge Advancement and Social Transformation.

ii. **Prioritized Research (PR) –** This category emphasizes on meeting the immediate national needs. Projects in this category should be multi-institutional, multi-disciplinary with industry linkages and commercialization potential.
Information and Communication, Manufacturing, Plant Production and Primary Products, Education and Training and Health fall under areas for Prioritized Research.

iii. **Strategic Research (SR) –** Projects under this category should focus for future competitive socio-economic environment or breakthrough in scientific field. These should be multi-institutional, multi-disciplinary with industry linkages and commercialization potential.
Design and Software Technologies, Nanotechnology & Precision Engineering, Specialty Fine Chemicals Technology and Optical Technology fall under areas for Strategic Research.

Research organizations and institutions of higher learning in the public sector are eligible under the IRPA Program to receive R&D grants. Private sector entities can participate in the program only in joint projects with the above-mentioned organizations.

Case 2: Singapore - Science and Engineering Research Council (SERC) R&D funding

The Science and Engineering Research Council (SERC) promote public sector research and development in the physical sciences and engineering. It aims to build a conducive environment for research by investing in R&D capabilities and human capital through the research institutes, as well as research programs in the universities. The Council seeks to develop a foundation of high quality research in the following key disciplines: Microelectronics, High Performance Computing, Material Science & Engineering, Infocomm Research, Manufacturing Technology, Data Storage and Chemical Sciences.

The Council works with the objectives to develop a foundation of high quality research in key disciplines; to nurture human capital for research; and to promote information dissemination and technology transfer. Research scientists and engineers from all local universities, polytechnics and non-defense-related public sector agencies are eligible under this scheme.

There are two modes of funding support for research proposals at SERC. They are:

i. **Public Sector R&D Projects Funding**

This is investigator-led research where proposals are invited twice a year and undergo a competitive merit review process for awards. All proposals are peer-reviewed. The Review Panel comprises researchers from academia and Research Institutes. The criteria for award include scientific merit, innovative ideas, potential economic significance of the research outcomes, and the track record of the researchers.

ii. **Thematic Strategic Research Programs**

The thematic approach aims to foster collaborations and greater linkages within the research community and between institutions. It also aims to achieve prioritization of strategic areas for funding. The Thematic Strategic Research Program supports proposals that satisfy one or more of the following objectives:

a. Creation of high impact

Research that leads to significant benefit to the economy over the medium to long term.

b. Development of enabling capabilities

Research that leads to the creation of enabling technology platform(s) and technologies that will benefit one or more industry clusters in terms of breadth in the diversity of applications and depth in the value chain.

c. Support for national priorities

Research that solves specific problems which may compromise Singapore's stability or impede her economic or social progress.

SERC also funds the Temasek Professorship, which brings together foreign, world-renowned leaders/professors to spearhead cutting-edge research projects in Singapore. The Temasek Professorship (TP) Program serves as a platform where renowned international R&D research leaders are invited to lead strategic research projects identified as imperative to Singapore's scientific and economic development. The TP Program serves as a "magnet" to draw good local and foreign researchers and students to engage in research activities in Singapore.

Case 3: Korea---The Highly Advanced National (HAN) Projects

As part of its globalization strategy, the Korean government developed a plan to select and develop strategic industrial technology requiring nationwide R&D investment. This plan, called the Highly Advanced National (HAN) projects, develops and assimilates core technologies in strategic areas where Korea will have the capacity and capability to compete on the level of more advanced countries. Korea intends to build and maintain its competitiveness in selected industries by concentrating its limited R&D resources.

A HAN project is a large-scale R&D project carried out through joint investment by the government and the chaebols (S. Korean business conglomerates) under a long-term project management system, which is supported by inter-ministerial cooperation and coordination. Various R&D actors such as universities, industries, and government-supported research institutes participate in each project. For the areas where domestic R&D capacity is lacking, international cooperation is actively pursued. HAN Projects places an emphasis on the concerted action among different interest groups and resource allocation by priority setting.

The Korean government created two categories of HAN projects. These are:

i. Product Technology Development Projects

This category of HAN projects concentrates on research and development of technologies for specific high-tech products that may have a substantial share in the world market. The objective of this category is to promote applied research and technical development based on national and international co-operation creating new, up-to-date, valuable, marketable products, procedures and services as a result.

Such projects will be financed under these categories that contribute towards making Korea a Premier Infocomm Hub. Emphasis will be laid on creation of a conducive pro-business and pro-consumer environment. Formation of the world's most advanced information and telecommunications networks, next

Generation Computers, Sophisticated Service Robots are some examples of preferred investment areas.

ii. Fundamental Technology Development Projects

This category concerns core technologies that are absolutely necessary to advance the economy, society, and human life. This category supports proposals that satisfy one or more of the following objectives:

- Maximize the ability of citizens to utilize ICT to actively participate in the information society;
- Strengthen global competitiveness of the economy by promoting informatization in all industries;
- Realize a smart government structure with high transparency and productivity through informatization efforts;
- Facilitate continued economic growth by promoting the IT industry & advancing the information infrastructure; and
- Become a leader in the global information society by playing a major role in int'l cooperation.

Some of the technologies targeted by the HAN projects are aerospace, automobiles, bioengineering, communications, computers, electronics, environment, machinery and metals, medical equipment, nuclear power, and semiconductors. It is under the auspices of these projects that inter national cooperation and technology transfer is currently being pursued.

Case 4: Hungary - Research and Technology Innovation Fund

In order to speed up economic growth in Hungary, the government has initiated the development and operation of a new, efficient innovation system. A **Research and Technology Innovation Fund** has been established by the National Office for Research and Technology. The goal of NKTH is to provide sufficient funding for innovation programs that aim to create innovative services and products. The Research and Technology Innovation Fund Policy declares that both the state and the business community have to fulfill their role in ensuring that research, development and industry are brought closer to each other and placed in the service of the country's economic advancement. To achieve this, the country needs coordinated education, research, development and innovation policies, as well as measures to stimulate the research and development activities of the private sector.

The Programs funded under Research and Technology Innovation Fund are intended to synchronize basic and applied research with technological development, to strengthen and ensure the efficient utilization of national research and development capacities and to improve Hungarian international scientific competitiveness. The program promotes

the R&D projects of consortia lead by Higher Education or R&D institutes and containing the companies taking part in the usage of R&D results. Preference will be given to projects generating a clearly detectable economic result in a short time. The main areas in which proposals are solicited include:

i. Support to the establishment of Co-operative Research Centers (CRCs)

The support is aimed at the establishment of research centers and to support their operation, in which close relations could be developed between Hungarian higher education institutions, other non-profit research facilities and members of the corporate and business innovation sector, and in which the education, research & development and knowledge and technology transfer can be integrated for strategic purposes.

ii. Proposals to support biotechnological research activities

The objective of the aid is to improve the competitiveness of Hungarian biotechnology
enterprises, and create modern, valuable marketable biotechnological products, procedures and services, in the case of which the advantages can be achieved without constituting a risk to human health or environment, taking into account the ethic requirements.

iii. Proposals in application of Information and Communication Technologies

The objective of the aid: development and test of marketable, new information and communication procedures, tools and services; establishment of large, information infrastructure with a large band width, based on experimental and modern technology, in the computer network of higher education and research institutions; in addition, promotion of the establishment and dissemination of new digital information systems and services based on image technology, as well as other technologies and skills related to those.

The projects to be funded are evaluated by independent experts. Apart from the micro- and small enterprises, every enterprise is obliged to pay at least 0.25% of its turnover into the Fund. The Hungarian government contributes to the Fund with an equivalent amount.

Case 5: Tekes R&D Grant to Companies

Tekes' primary objective is to promote the competitiveness of Finnish industry and the service sector by technological means. Its activities aim to diversify production structures, increase production and exports, and create a foundation for employment and societal well-being.

Knowledge, competence and innovations are the foundation of the Finnish welfare state. Finland is a knowledge-based society offering an internationally competitive and attractive environment for entrepreneurship and innovation. Tekes is part of the cutting-edge innovation environment that creates the basis for the success of customers, as well as the economy and society at large.

Together with its partners, Tekes provides a comprehensive set of high-quality innovation services. Tekes independently promotes and coordinates R&D projects and programs, in addition to maintaining cooperation within international networks. Core activities of Tekes include:

a) Activation for innovation

Tekes encourages companies to improve their capabilities to develop and apply new technologies. Activities are targeted at new technology based firms and SMEs in particular, as well as new businesses and international cooperation. Large companies are encouraged to participate in long term research projects, which address major technological challenges and involve significant networking with research institutes or SMEs. Activation also promotes regional development.

b) Technology programs

Technology programs are launched in areas vital to the future of Finnish industry. The programs strengthen the national knowledge base, promote the renewal of businesses and industry, competitiveness, research, and enhance cooperation between companies, research organizations and the public sector. Programs emphasize the versatile development and utilization of international and regional technological cooperation.

c) Selective project funding

Tekes' funding is targeted at projects which produce new knowledge, bear high technological and commercial risks and in which the impact of Tekes' funding is substantial. The selected technology focus areas at Tekes are technologies and competences that will continue to develop and will be invested in to create new application potential. Development in these areas will enable new technology leaps.

The focus areas chosen are selected strategic development areas within ICT, biotechnology, materials technology and nanotechnology.

Funding is allocated to projects which are assessed to generate the greatest long term benefits to the national economy and society, either directly or indirectly, in relation to the public investments made. Both SMEs and large companies are eligible for receiving funding from Tekes, however, large companies must propose projects in cooperation with universities or SMEs. Also, the projects proposed by large companies are expected to be more challenging than those proposed by SMEs to receive the same amount of funding.

d) Development of the innovation environment

Innovation services are developed and provided in cooperation with other financiers and expert organizations. Tekes' contributes to the development of an internationally, nationally and regionally networked innovation environment. Tekes supports the Ministry of Trade and Industry in the formulation of technology policy. The innovation environment is also developed through activities within selective project funding, technology programs and activation for innovation.

2.3 Inferences drawn from comparison of Historical R&D Efforts with International Best Practices

Vast diversity can be observed in the objectives and achievements of R&D projects of the government. Research has been done in many areas and a lot of that research produced result oriented outcomes. A positive sign has been the continuous growth and emergence of such organizations to carry out research in industrial and agricultural regime. Though success and failure is a relative term and we must understand the limitations faced by many such organizations, yet it has been the fact that the aim and objectives could not be met with full potential. This R&D fund in more than ways would be a continuation of the previous efforts in the ICT regime. Most of those efforts yield some productive results but never materialized their full potential. This section would trace the reasons for such shortcomings. Some of the most important reasons include:

2.3.1 Lack of Monitoring Systems

Improper or unstructured monitoring and evaluation mechanism could be the key difference between success and failure. Most R&D initiatives in Pakistan have defined and very definite monitoring mechanisms yet at most instances it could not be enforced properly. For facilitating the linking of goals and achievements, R&D funds should adopt a technique used by many organizations today, i.e. Management by Objectives. MBO is a process through which specific goals are set collaboratively for the organization as a whole and every unit and individual within it. Periodic reviews are carried out to ensure that plans are being implemented as expected and that goals will ultimately be met. This approach can also be used in research activities for identifying and removing obstacles, solving problems and altering action plans that are not achieving the expected results. Organizations that follow MBO, conduct an appraisal at the end of the goal setting cycle, in which managers meet each of their sub-ordinates to assess their performance over the cycle. The appraisal typically focuses on the extent to which goals were met, as well as on shortfalls, the reasons for them and actions that can be taken to prevent the same difficulties in future. In the absence of such regular follow ups, the research organizations cannot learn from their own mistakes, the efforts across their different departments would be poorly coordinated and their output would often remain below full potential. The achievements made by staff members should be praised and recognized regularly to increase their motivations. The jobs of the researchers must not be restricted to mere following of standard operating procedures; instead they should be involved in the broader goals of their activities.

2.3.2 Highly Centralized Organizational Setups

Many research bodies in Pakistan have been functioning according to the centralized rules of management. There has been excessive focus on following the chain of command and most of the power and authority are retained at the top of the hierarchy. This causes unnecessary delays in large research organizations, since top level managers do not have the time to make all the major decisions. This problem becomes more defined when the research setups of an apex body are geographically dispersed, as is the case with some research organizations in Pakistan. It is impossible for the top executives to keep abreast of the details of operations at various locations. Secondly, the upper management cannot keep up technologically, while the lower staff, by virtue of being closer to the problem, can make better decisions. These issues related to strict adherence to a chain of command, can be combated by increasing decentralization in research bodies across the country. Decentralization means delegation of power and authority to lower levels in the hierarchy of an organization. It leads to faster decision making at the lower levels, since most decisions do not have to be referred to the top managers. The executives of the research funds will then have more time to focus on broader goals. Also, decentralization enriches the jobs of lower-level employees by offering the challenge associated with making significant decisions that affect their work. Hence decentralization can be used as a capacity building tool for the employees of research organizations. Finally, decentralization often leads to the establishment of relatively independent units, such as divisions, whose output is easier to measure as compared to that of the entire organization.

2.3.3 Absence of an Updating Mechanism for Research Objectives

With rapidly changing market demands, research activities of the institutes and centers should be regularly reviewed to assess the appropriateness of the goals and to change them or add new ones as necessary. The purpose of the goal-setting and planning processes in MBO is essentially to coordinate efforts towards *important* organizational goals. Given the rapid pace of technological advancement in the present era, revisions in research objectives are necessary to accommodate major changes in circumstances.

A few R&D departments in Pakistan were created decades ago and have not been updated, neither in terms of their objectives nor operations; hence they are far from current socio-economic settings, in terms of their strategic focus. What must be done is conduction of a survey through which demand for research can be identified within different sectors e.g. education, health, industry, agriculture etc. In such surveys, opinions of all key stakeholders of the respective sectors should be incorporated and emphasis should be placed on leading market players in the sector.

The Research Funds in technologically advanced economies provide some direction to bidders through defining focus areas. However, the focus is not too narrowly drawn to leave room for the researcher's creativity. It may not be possible for the fund to tap on some of the most current or relevant themes on its own and it is only prudent to allow inflow of innovative ideas from various stakeholders. Public workshops may prove to be a useful exercise in gathering input of the stakeholders for reviewing focus areas for research within a sector. Another important step could be complete separation of the operational and policy mechanism.

2.3.4 The Need to Install Effective Evaluation Mechanism

The performance results and accountability of all R&D programs must be carefully reviewed and evaluated by expert groups in the relevant field. The criterion for evaluation of research programs are *validity of program contents, efficiency of program management* and *effectiveness of program results*.

Validity of program contents: The validity of a research program is assessed by considering the appropriateness of the aim and scope of the program. This includes evaluating whether the objectives of the research are relevant to the current technological demands in the industry. Alignment of research activities with industrial demands has been a matter of concern for domestic R&D initiatives. Research has been treated as something that is confined to the laboratories and at most, to research journals. The result is that though we have a large theoretical base of research studies, their linkage with the industry is missing in many respects.

***Efficiency of program management*:** Evaluating the efficiency of a research program involves ascertaining whether the activities of the program are planned according to a strategic focus. A major flaw with the many R&D activities in Pakistan has been that they have lacked a thematic approach. Some of the research bodies have been functioning without detailed considerations regarding how the technologies developed will be used in creation of more advanced technologies. In the absence of a technological road map that defines a step by step journey towards a larger goal, the potential of any achievements that were made could not be fully utilized.

Effectiveness of program results: While evaluating the effectiveness of program results, the commercial, social and technical contribution made by the research program to the relevant industry and the economy at large is assessed. Although some research funds in Pakistan have had elaborate research objectives, the commercial output of the to-be-created technologies was not given due consideration. There has been hardly any evaluation of any increases in revenue or reductions in cost generated due to R&D in a specific industry. Research activities in general were not geared towards creating new jobs and business opportunities in the society.

In order to measure the economic and technical contribution made by these research bodies, their performance should be assessed on quarterly or semiannual basis through internal evaluation systems. In addition to internal performance based evaluation of employees and units, external evaluation by a Committee consisting of outsiders is also necessary. The involvement of outsiders in the evaluation will ensure objectivity of the analysis.

2.3.5 Creating an Environment that Stresses on Accountability

The results provided by the evaluation committee should be used by policy makers in anticipating prospective areas to invest in and to shape a future R&D policy. Furthermore, grants should be redirected from the funds that fail to achieve their objectives. This will create an environment of accountability for R&D to citizens of the country. The general public in Pakistan is not even aware of many existing research bodies, though they have impressive brick and mortar setups. There is no media coverage of the activities and the outputs of such bodies. This allows the R&D institutes to stay further in the backwaters. The input output ratio of the activities of these institutes should be made public to make them interact more with various sectors of the economy.

One way of increasing accountability among bidders for the funds allocated to them, as observed in the international best practices, is to fix an amount that is repayable to the fund. This would ensure that the recipient of grant makes an optimum effort to make the project a success. In this way, research grants will not be treated as free money that may or may not be profitable.

A significant reason behind inability of R&D activities in Pakistan to produce significant results is that they have been created in the past as mere attached departments of the ministries. It has been observed that most of the successful international R&D funds are managed as an independent entity with a clear decision making structure of their own. Such entity brings a focused perspective to the fund management that remain unhindered by conflicts of interest and bureaucratic delays.

2.3.6 Inability of Local Research to Close the "Innovation Chasm"

While evaluating solicited proposals, additional merit should be given to programs that collaborate with a greater variety of stakeholders, i.e. from industry, academia and research institutions. In all examples of international best practices quoted in section 2.2, while evaluating proposals, preference is given to those projects that promote wider collaboration between the three. This would provide the only way to break the

'innovation chasm' that currently exists in Pakistan. The local research is not proving to be fruitful for the local industry. Whatever research is being carried out locally is identified and picked up by overseas technology resources. The products developed overseas eventually come to the Pakistani markets. The economic gains of such product development are then naturally reaped by their foreign promoters. Hence we remain dependent upon technology transfer for developing our local market.

An important criterion for selection of proposals is participation of foreign partners in the research program. This can lead to increase in Pakistan's international technical competitiveness as well as build mutually beneficial relationships with other countries. Bidders with international linkages, for example multi-national companies, will be able to bring an international perspective to the local research. Last but not the least, those proposals should be preferred that involve participation of women engineers and researchers. In this way, R&D funds can be used for bringing the female population of Pakistan into important technical fields.

2.3.6 Conclusion

To sum up, R&D must be made a mainstream activity of the government. Priority areas should be defined keeping in view the latest developments in science and technology in the world and R&D budget allocated to different sectors accordingly. Surveys should be carried out to identify the demand for research in specific areas within sectors. Opinions of the leading market players must be incorporated in such surveys, to gear the R&D programs towards strengthening industrial competitiveness. The research bodies should function as individual entities operating according to modern management techniques. There should be increased decentralization in research institutes. Performance based evaluation mechanisms need to be installed in each project to increase their efficiency. External evaluation by a committee consisting of outsiders at the completion of a program should be used to formulate future R&D policy. Finally, proposals from both public and private sectors should be solicited for R&D funding in order to increase their competitiveness of local research.

CHAPTER THREE
POLICY THRUST & BUILDING BLOCKS

3.1 Policy Thrust

With the world becoming a true global village, the concept of benchmarking and relative measurement has become more complex than ever. It must have always been imprudent to decide on policy issues in isolation but in toady's world, the relative yardsticks have become more important than ever. The formulation of this policy is in the backdrop of strong forces of globalization that at the same time shape the threats as well as opportunities present in our environment.

3.1.1 Globalization Forces

It is acknowledged that in the new information age, the mere use of information, knowledge and technology can improve the socio-economic development fortunes of a given nation. However, evidence shows that those nations, who in addition, are involved in the development as well as in the selling of information (and information products), knowledge (and knowledge products) and technology (and its products), are moving faster on the socio-economic development scale compared to others. There is no doubt that in the new emerging economic order, the fundamental basis for wealth creation and national prosperity are information and knowledge, and that, Pakistan cannot afford to be without either of these. In this scenario, following four forces caused by globalization have shaped the policy:

- Migration of millions of service oriented jobs from the 1st world to the 3rd world
- Level playing field created by ubiquitous availability of all sorts of information through out the globe
- Removal of protection given to industry by political entities leading to intense competition.
- Increasing role and use of knowledge to enhance productivity.

3.2 Building Blocks of the Policy

The policy will be founded on pillars that would strengthen its claim to be a change agent for the future. These are as follows:

Building Block 1: Enabling Government directives comprising the supportive policies

The Government's total commitment will continue to support promotion and funding of R&D initiatives in order to enhance Pakistan's capacity to develop and produce ICT products and services, as a step towards a globally competitive ICT sector.

Building Block 2: Creation of a Legal System that supports a globally connected knowledge based economy and secures intellectual property rights

The development and implementation of a suitable legal and regulatory framework and environment can among other things support the development of the local ICT sector and in addition ensure a competitive environment for the development and provision of communication services, stimulating innovation, creating scope for the price reductions and increasing consumer's choice. The rapid changes and developments within the communications sector brought about mainly by the advances in technologies and services has made it necessary for countries to create and operate a dynamic legal and regulatory framework that is responsive to technological changes and advances.

The Government shall enact the necessary intellectual property laws and cyber-related legislative provisions to govern and regulate ICT-related activities within the country. Legislation to promote and facilitate electronic commerce and other Internet-related activities in the country shall be enacted in addition to facilitating the enactment of laws relating to: intellectual property rights; data protection and security, freedom of access to information; computer and cyber crime, necessary for facilitating the country's participation in the information age.

Building Block 3: A well trained and efficient young manpower

It is recognized that human resource is the key to developing and transforming Pakistan from a predominantly agriculture based economy into a predominantly information and knowledge based economy and society. It is acknowledged that the extent to which Pakistan will benefit from the advances and the opportunities of the emerging information age will depend on how the country is capable of developing and harnessing its human resource to initiate, support and maintain its development towards a knowledge based economy.

Specifically on ICT related skills, Pakistan like many developing countries suffers from a shortfall in critical ICT skills and expertise required for the development and support of ICT applications and systems within the public and private sectors. Without a sustained effort to train workers in key ICT skills, the limited availability of skilled ICT personnel may place an upper limit on development and deployment of ICT within the economy and society.

Building Block 4: Efficient and cost effective infrastructure

Information and telecommunications infrastructure deployment and usage is a necessary precondition for sustained economic growth in Pakistan. There is no doubt that deployment of a nation's communications infrastructure will be essential for speeding up the process of the deployment and exploitation of ICTs within the society and economy.

Pakistan's telecommunications and communications infrastructure is currently under-developed and limited in coverage. It is acknowledged that special policy measures and initiatives will need to be aimed at developing the communications infrastructure to improve universal access and service.

3.3 Policy Challenges

It is recognized that if Pakistan is to move her industrially weak, agriculture-based economy towards information and knowledge economy, she will need to develop and implement integrated ICT-led development policies, strategies and plans set within the wider context of the socio-development objectives of the country. There is no doubt that for Pakistan to compete and prosper in the new emerging global economy, which will be dominated by information and knowledge based economy, she will need to embrace and harness ICTs to facilitate her development process.

Pakistan's success in the emerging knowledge revolution and technological age will depend on the extent to which it manages to take advantage of rapidly evolving technologies. It is acknowledged that, although these new technologies present major challenges to developing countries like Pakistan, they also provide considerable opportunities for sustainable development and for improving competitiveness of key sectors of the economy like agriculture, industry and services.

The policy design facilitates the processes to cope with key challenges faced by the ICT industry in Pakistan in particular and the economy of Pakistan in general. A careful evaluation of the economic forces reveals the following challenges.

- The effects of globalization exposing the local industry inefficiencies and underperformance
- Weak scientific research and development base coupled with the historic failure of most of the R&D organizations
- ICT education that is not aligned with national industrial needs and shortage of practically trained professional human resource support for the industry
- Lack of effective liaison between academia and industry resulting in absence of a strong link between academic research and economic productivity
- Absence of a cohesive and synergic approach characterized by optimal private-public sector partnership and a common vision for immediate term and long term goals
- The rising trends of unemployment despite the positive industrial growth and stability
- The pace with which technology in today's world is changing and causing constant adjustments in the production processes and economic value of products

- The challenge of turning the youth of the country into a dynamic workforce for future

- The provision of a conducive environment for gender equality and participation of womenfolk in the overall development of the economy

- Increase in the reach of industrial growth to the less developed and marginalized communities and geographical regions

- The effect of rising population causing the decline in per capita income and negative pressure on the indicators for economic performance

- The low job creation capacity of the economy with slow change in focus from conventional and traditional sectors to high tech sectors

- Huge debt burden of the economy hindering the effective allocation of resources to the productive sectors of the economy

With challenges identified and objectives established, the key focus must be to promote innovation through a mechanism that would have measurable commercialization potential to help create more jobs, strengthen the local research base and promote technology oriented solutions for the local and global industry. Our policy should demand the identification of an innovation value chain. This value chain must then create a focused vision as to what themes and projects would serve this encompassing goal better.

CHAPTER FOUR
POLICY ENVIRONMENT

4.1 The Innovation Value Chain

In order for this R&D initiative to turn Pakistan's economy into a knowledge based economy by achieving the specific objectives outlined in the earlier sections, it would be imperative that the focus of the policy must be directed at creating a complete value chain rather than focusing on development of projects. As opposed to isolated projects, a value chain emerges from market demand and is more responsive to the current knowledge revolution. Hence this policy makes a commitment to focus on creating value chains that link the local research with local product and market development. The value chain creation triggers and sustains innovation in the sector in which it is initiated, hence the name Innovation Value Chain (figure 1).

The Innovation Value Chain in the ICT sector begins with the research bodies (organizations and funds etc) operating in a country in this sector. The National R&D Fund hence comes at the first stage of the value chains in ICT sector of Pakistan where it plays a significant role on various fronts. The Fund begins by developing, adoption and enforcement of international standards within the ICT industry to facilitate the development of world-class and globally competitive local ICT industry. These include the necessary technical as well as legal standards to encourage innovation in ICT, bringing the local products at par with those of global ICT players and to support wide-spread use of electronic commerce.

The development and implementation of a suitable legal and regulatory framework and environment can among other things ensure a competitive environment for the development and provision of communication services, creating scope for the price reductions and increasing consumer's choice. The rapid changes and developments within the communications sector brought about mainly by the advances in technologies and services has made it necessary for countries to create and operate a dynamic legal and regulatory framework that is responsive to technological changes and advances. The R&D Fund will thus dictate the development of necessary intellectual property laws and cyber-related legislative provisions to regulate ICT-related activities within the country and will integrate the opinion of key stakeholders in this process.

The R&D Fund will promote research for development of products and services that have significant usefulness for the industry. Many research funds created in various

fields in Pakistan in the past have had elaborate research objectives; however, the commercial output of the to-be-created technologies and services was rarely taken into account. There has been hardly any evaluation of any increases in revenue or reductions in cost generated due to R&D in a specific industry. Research activities were not geared towards creating new jobs and business opportunities in the society. The National R&D Fund will improve upon this situation by selecting such research proposals for funding which have significant commercialization potential. Such proposals will be preferred which have measurable and auditable output.

The Innovation Value Chain is a cyclic process. The commercialization of newly developed technologies will result in increasing the industrial revenue which will in turn add to the National R&D Fund in the form of 0.5% - 1% contribution of annual gross revenue by all players of the ICT sector. This process will stimulate the industry to participate in local R&D.

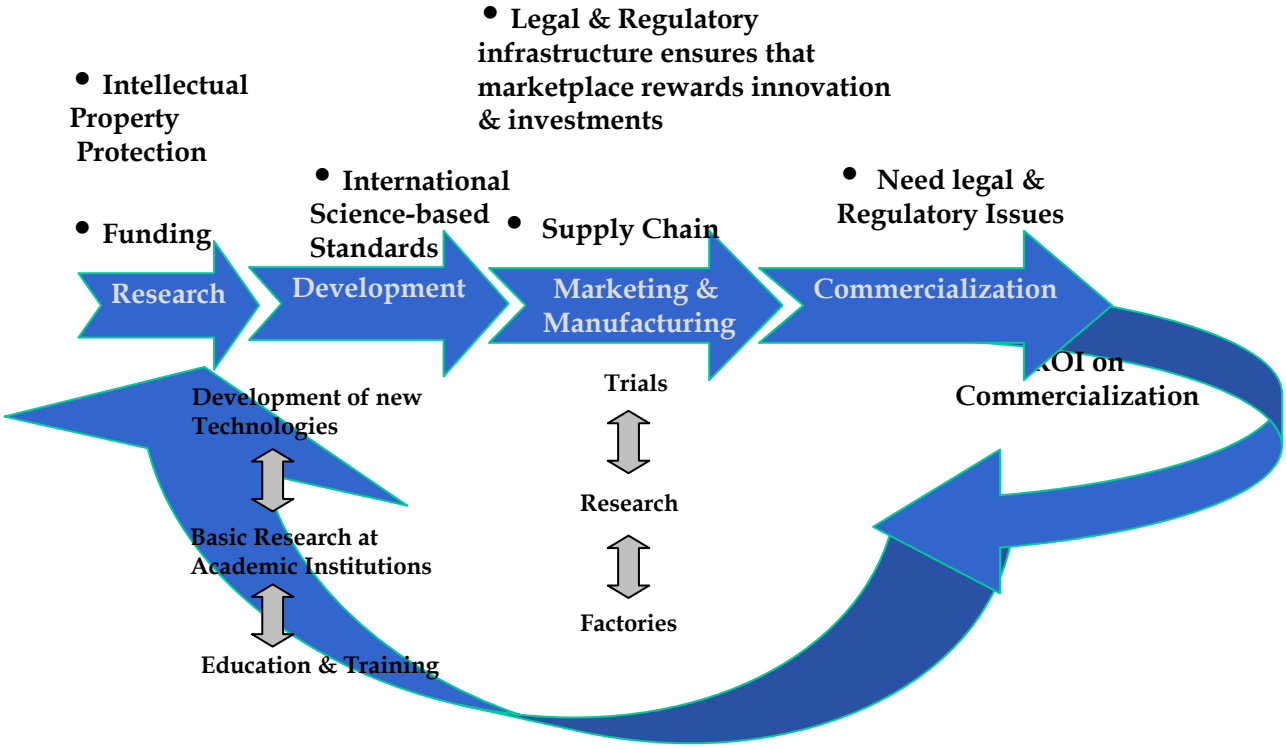


Figure 1: The Innovation Value Chain

The Innovation Value Chain ensures that the research carried out via funding by the R&D Fund is well connected to the industry. Additional merit will be given to those research programs that collaborate with a greater variety of stakeholders, i.e. from industry, academia and research institutions. This provides the only way to break the 'innovation chasm' that currently exists in Pakistan. The R&D Fund will ensure that the local research proves fruitful for the development of the local industry and that all basic research eventually transforms into applied research for developing new technologies in the local ICT sector.

Human Resource Capability building is one of the building blocks of this policy. The Innovation Value Chain remains incomplete without taking into account the development relevant IT skills in the country for using the newly developed technologies and for improving upon them. Pakistan like many developing countries suffers from a shortfall in critical ICT skills and expertise required for the development and support of ICT applications and systems in both public and private sectors. Without a sustained effort to train workers in key ICT skills, the limited availability of skilled ICT personnel may place an upper limit on development and deployment of ICT within the economy and society. Hence R&D Fund will continue to promote, both directly and indirectly, the updating of skills of the human resource of the country.

4.2 Integrated Thematic Approach

The key to achieving the policy objectives is the *Integrated-Thematic* approach. It is extremely desirable that the ICT fund give tangible benefits in as short a period of time as possible, therefore, it would make sense to choose a few key nationally important themes in which to invest funds, so that significant progress can be made in solving problems pertaining to these themes.

While selecting a theme for funding, it is necessary to identify all participants of the entire supply chain. This policy stresses on focusing on a complete value chain instead of isolated projects, to ensure economic gains as a result of research and development. In the context of this policy, a theme is a process through which a product or service is developed and marketed. A Theme encompasses activities of all possible stakeholders that participate in creation and marketing of an end-product.

As explained in section 4.1, the value creation process or theme begins from identification of commercializable products and services. The required research is then put into manufacturing of requisite technologies for the development of such products and services. The modern ICT technologies have led to an era in which the provision of products and services involves a variety of intermediaries before they become marketable.

Example of Integrated Thematic Approach:

Information and communication revolution has made Medical Transcription Services common all over the world. The provision of these services is an example of how Information Technology is merging into other disciplines such as medical sciences. IT has revolutionized the provision of health care, however it must be noted here that the quality of the end product i.e. medical consultancy is dependent on the performance of a variety of specialists. A fault in any one of these will translate into lack of

competitiveness of the end product. This is where the need to integrate all stakeholders in the value chain comes to surface.

Provision of Medical Transcription Services involves the following different experts:

- Medical Specialists
- Call Centre Expertise
- Software Engineers
- Computer Hardware Specialists
- Management and Coordination Services

The case is similar for legal transcription services, where Lawyers must be integrated in the value chain. Emergence of global transaction processing systems is also an example of how expertise in IT is combined with financial advisors, accountants and HR specialists (in case of Payroll Outsourcing Services and HR Record Management). In this scenario it is imperative that any funding for increasing use of Information and Communication Technologies in the economy must take into account the quality of services provided by all intermediaries. For example, in the case of Medical Transcription, doctors, in addition to being experts in their area, must also be trained in efficiently using ICT equipment. The support staff likewise will have to be trained in some level of medical terminology to produce a consistent end product.

The "integrated" part of the Integrated-Thematic approach implies that a concerted effort is made to find solutions to all problems related to the supply chain of a theme, even if the problems do not fall in the ICT domain. For non ICT related problems relevant funding organizations are identified and a coordinated effort is made to solve these problems.

4.3 Interactive Approach

It must be understood that ICT development alone would be insufficient for the emergence of effective results especially in the long run. To achieve the prime goals of human resource capacity building, job creation and poverty alleviation through sustainable economic growth, the presence of many other factors is necessary. It must also be understood that the application of ICT requires both technological and information infrastructure and the challenge is to provide both components.

In countries like Pakistan with a predominant rural setting, the information infrastructure establishment is quite complex and must be complemented by developing the technological installations that in a pure R&D perspective must be driven through an indigenous development program. The overall strategy must be complemented by a development action plan to guide an optimal outcome for the masses.

This policy advocates a comprehensive national framework for ICT policy formulation and implementation. The main objective is to create and use ICT to bridge the digital divide in the country in its entirety. To this effect, the policy suggests the following components to be translated into policy implementation programs.

4.3.1 Provision of Infrastructure

A region specific infrastructural development approach has to be designed. This approach should include projects aimed at providing infrastructural support in terms of backbone ICT facility to various segments of the society and establishment of a national broadband satellite infrastructure.

4.3.2 Establish a vertical and horizontal communication grid

It is necessary to connect major cities, regional cities, urban centers, and rural towns through vertical and horizontal communication grids to deliver effective and efficient services and provide citizens with wider public access through national network systems. Congested Cities should be transformed into Cyber Cities and connected to the vertical and horizontal network centers. This provides a framework for technological transformation, which will increase national consciousness originating from the grass roots. This is an indispensable necessity to empower the grass roots to mitigate the unilateral process of metropolitan linkages, which mainly serve the interests of multinational corporations. This is somewhat a remote objective, nevertheless it can be and must be achieved to break the cycle of perpetuation of the gulf between core and

periphery and to allow fairer distribution of capital, particularly the transfer of technology. This horizontal and egalitarian national consciousness is necessary to challenge the growing paradox of the information society, which reflects in the process of digital divide in the unfolding rift of social spatial spectrum.

4.3.3 Establish an Integrated Development Framework

The digital divide could jeopardize all efforts by government to establish an efficient and effective e-Government environment. Therefore, government should take a coordinated effort of an awareness building of the importance of user acceptance of new ICT technologies. Imparting technological skills in the areas of governmental service and participatory activities must be embedded in this coordinated effort. This will enhance the citizenry involvement and participation in the e-governance.

This policy advocates the establishment of an environment that is conducive for the creation and diffusion of information technology. Regulatory policies must be dictated to facilitate the transfer of technology. The legal, institutional and logistical framework has to be created, well organized and coordinated in order to guarantee the growth and development of information infrastructure in the country.

4.3.4 Use ICT to develop Private Sector, and healthy triangular partnership between Government, Private Sector, and Civil Society

The policy advocates that innovative public-private-civil society partnership is necessary to install regional broadband satellite infrastructure, enhance physical network construction and service provision. The policy also encourages promotion of private sector development by creating a conducive legal framework for private sector investments in the industry. The objective is to strengthen the private sector in an active way to ensure that it is capable of acting effectively as an engine for growth and poverty reduction. The development of private sector is an important strategic priority of the government for increasing the economy's job creation capability.

4.3.5 Create Gender Oriented ICT Policy

This policy must rest on the understanding that technology must be adapted to fit the needs of both rural and urban poor women in order to have an impact on their economic status and improve their living conditions. Rural agricultural women and urban informal sector women should have technological skills and access to their respective stock of information (agricultural and market information), and health and educational information on a constant basis. This information access must be built by taking into account their daily community interaction network. Application of ICT to the existing community interaction network will enhance their social capital base utilizing the various opportunities offered by the information society.

CHAPTER FIVE
STRATEGIC FOCUS OF THE POLICY

5.1 Strategic Direction

The strategic direction will set the roadmap for the future. The strategic focus must be multidimensional and each dimension must be addressed by milestones and action plans. The following strategic direction statements must lead the way:

- Establishing an environment where the national and international private sector, based on market forces, can exert its full potential and make Pakistan achieve the comparative advantage in its core strength areas in near future

- Invest in human resource development on a sustained basis so that Pakistan's economy remains competitive as technology progresses globally at an astounding pace.

- Making ICT products, services and international quality education accessible to the general public and increase employment through this means

- Increasing the use of ICT products and services in nationally important sector of the economy

- Creating and establishing knowledge-based industries and using ICT to increase global competitiveness by focusing on industrial processes, product development and innovation

- Enhancing ICT's role as key enabler and thus unleashing the potential of individuals, organizations and businesses to become more productive and efficient, and to create new ideas that enrich lives and produce new value thus improving national productivity and individual quality of life through development of information rich economy

- Providing a structured path to the orderly development of the country into an information and knowledge-based society within next 10 years

- Turning Pakistan into an e-enabled society where empowered citizens have access to technologies that will provide quality education, efficient government service, greater source of livelihood, and a better way of life

- Taking the dividends of ICT to next tier of cities and villages and to marginalized communities

- Use ICT to provide good governance to citizens of Pakistan

- Creating a vibrant, safe, efficient, livable society with the active use of ICT products and services

5.2 The interaction of industry driven R&D and the ICT industry eco systems (fig.2)

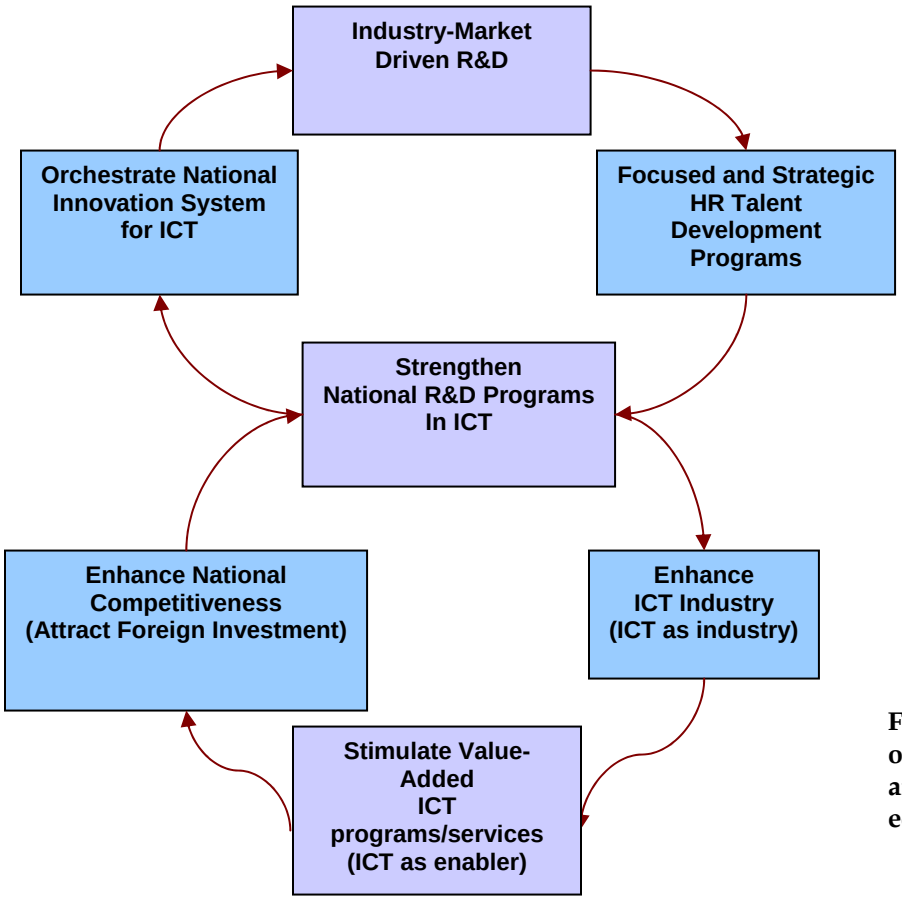


Figure 2: The interaction of industry driven R&D and the ICT industry eco systems

The research and development activities will to a large extent be aligned with industry and market demand. The human resource development funding will also be aligned with the industrial needs. As this alignment in R&D and HRD funding is achieved we will by policy design strengthen ICT production and the innovation eco system in the country. This innovation eco system will in turn strengthen the development and consumption of value added ICT products and services. These ICT services will

positively impact the national productivity and we will have two eco systems positively interact with each other.

CHAPTER SIX

ROADMAP FOR IMPLEMENTATION OF POLICY PRIORITIES

6.1 The Objective

The National R&D Fund Policy sets out Pakistan's road map in terms of the vision, objectives and policy priorities for developing Pakistan's information society and economy. The ultimate objective is to: *accelerate Pakistan's socio-economic development process towards the realization of the vision to transform Pakistan into a high income economy and society that is predominantly information-rich and knowledge-based within the next two decades or less.*

This Policy will have an operational life of 5 years. It provides a roll out plan to exercise the provisions of the policy extending over a period of five years, which shall be implemented within the life of the Policy. This roadmap addresses the specific aspects of the broad policy issues and commitments of the policy statement.

As a working and living document, it is anticipated that, necessary periodic revisions will be made in relation to its key elements to meet changing developmental objectives and priorities as well as changes in the global economy and advances in the technological environment.

All the subsequent sections in this chapter have a recommendatory status and they are under no circumstances binding on the R&D Fund. Only the Board has the discretion to implement these roll out plans after having it reviewed and modified if needed.

6.2 Roll Out Plan for Exercising the Provision of the Policy

To facilitate the process of transforming Pakistan into a predominantly information rich and knowledge based society and economy, the Policy defines the five priority areas. The policy implementation in these priority areas will be a phased process, i.e. the implementation will gradually phase from the basic priorities to advanced themes. In each successive year, funding will decline in the former category and will be replaced by the latter.

	Funding Priorities	Implementation Category
1.	HR Capacity Building	Immediate Term or Basic Category
2.	National Productivity Enhancement	Short term
3.	ICT Product Development	Medium Term
4.	ICT Market Development	Long Term or Advanced Category
5.	Multi-Sectoral Support Program	Long Term or Advanced Category

In the initial phase of its functioning, the Fund will concentrate the major portion of its resources in Human Resource Development. This investment will be expected to give returns to the industry in the immediate or short term time frame. Second Priority will be given to National Productivity Enhancement for identification of comparative advantage and capitalizing on this advantage through development of indigenous industry. Simultaneously, investment will also be made in Product and Market Development and Multi-Sectoral Development via ICT proliferation, however, initially a very small portion of the funds will be dedicated to these areas.

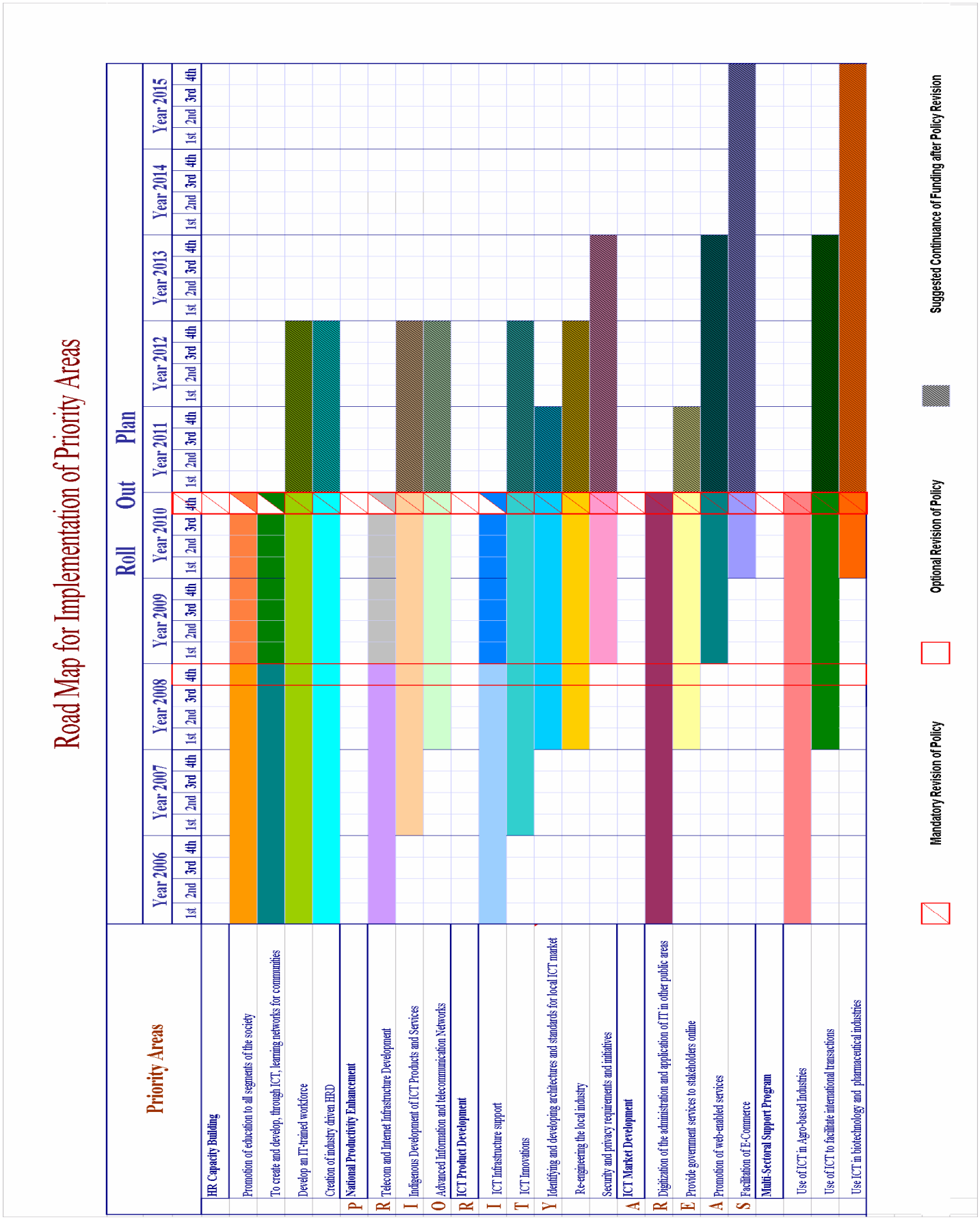
In later phases of operation, when R&D fund has successfully laid strong foundations of capable human resource and has caused sufficient exhaustion of the existing comparative advantage, more funding will be allocated to areas of product and market development in ICT sector.

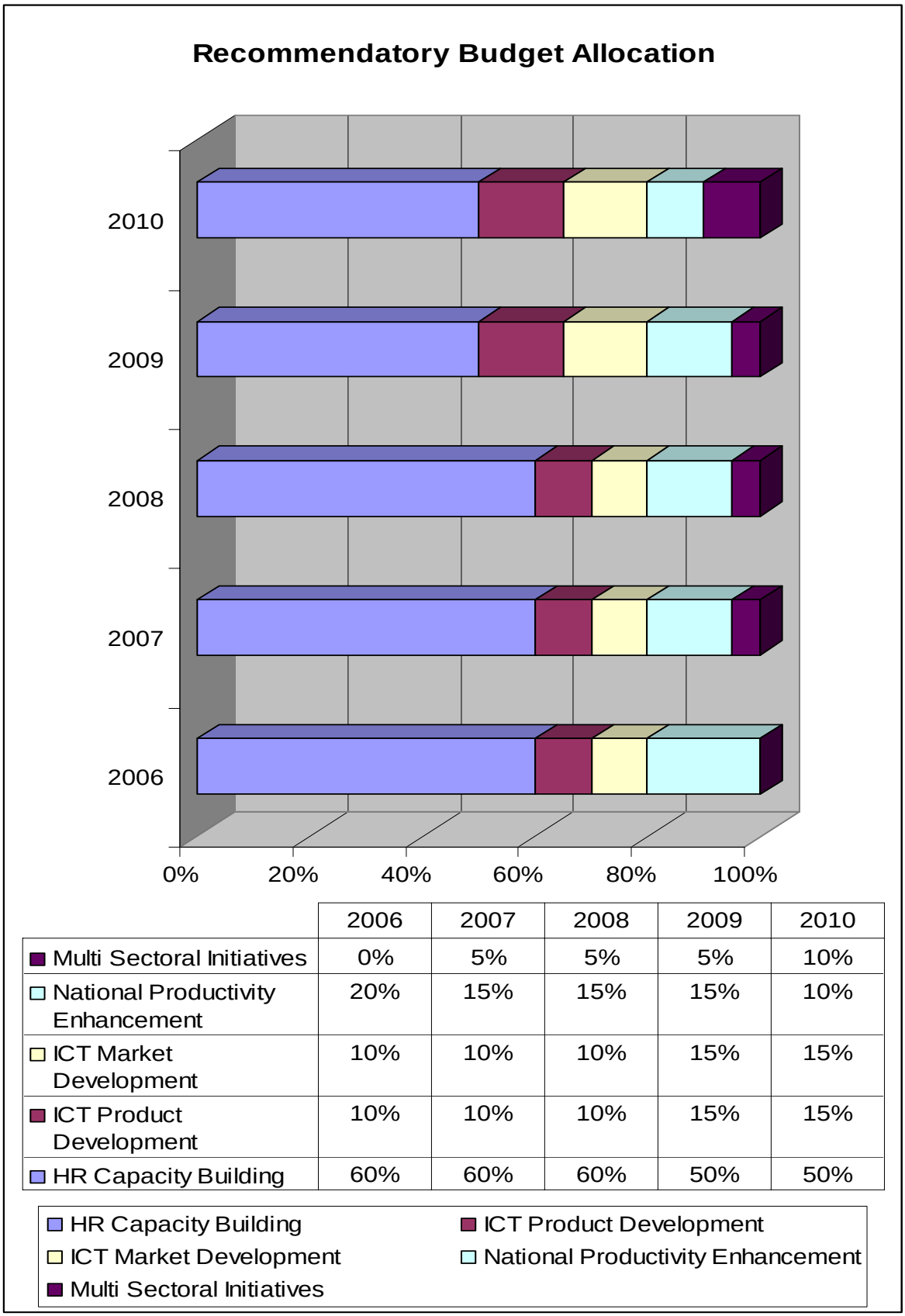
6.2.1 Explanation of Gantt chart for Roll out Plan

The Gantt Chart for Roadmap for the Implementation of Priority Areas shows the time frames within which objectives for various key areas will be pursued and strategies implemented. The fund will start functioning from mid-fall 2006. (The year dimensions mentioned in the roadmap correspond to the financial years). In the first three years of its functioning, the Fund's extensive focus will be on Human Resource Capacity Building and National Productivity Enhancement. In the last two years of its operation the focus will shift towards ICT Product Development, ICT Market Development and Multi-Sectoral Support Program.

After three years of functioning, this policy statement *may be* reexamined by the Board for required adjustments in its priority areas. A revision in the policy objectives would then take place to accommodate these changes. However, after five years of its functioning, the Board *must* reexamine the priority areas. As shown in the Gantt Chart- Road Map for Implementation of Priority Areas, the policy aims at a five year roll out plan and there is a *mandatory revision of policy* that must take place in the last quarter of the fifth year of functioning. However, this policy also envisages the possible areas for investment after the policy revision. The Board may continue to fund these areas (represented by shaded portions in Gantt Chart) as per its discretion after the policy revision.

The recommendations are made till year 2010. From that point onwards the themes must be redefined.





	2006	2007	2008	2009	2010
Multi Sectoral Initiatives	0%	5%	5%	5%	10%
National Productivity Enhancement	20%	15%	15%	15%	10%
ICT Market Development	10%	10%	10%	15%	15%
ICT Product Development	10%	10%	10%	15%	15%
HR Capacity Building	60%	60%	60%	50%	50%

Chart 2: Years of Implementation vs. Magnitude of Funding for Priority Areas

6.3 Objectives and Strategies to be pursued within Key Areas

In the following pages is presented the rationale behind each funding priority and the time dimensions in which it will be pursued by the National R&D Fund. Projects on all the priority areas will be pursued simultaneously; however, more objectives of immediate and short term categories will be pursued in the first three years of functioning of the Fund. In the subsequent two years, a greater number of objectives of the medium term and advanced term will be pursued.

6.3.1 Human Resource Capacity Building

Policy Context

The Government acknowledges that the young population of Pakistan can be transformed into an asset by adding value to human resources and providing the environment for utilizing those resources for socio-economic development process. The development of people to support the process of moving Pakistan into an information society and economy is therefore top priority of the Government and the critical role that ICTs can play in this area is fully recognized and shall be promoted by Government.

As part of the objective aimed at producing the right types of skills and human resources required for developing and driving Pakistan's information and knowledge-based economy and society, the Government will put in place and facilitate the implementation of a comprehensive human resource development program targeting critical skill areas across key sectors of the economy for supporting the development of Pakistan's information society and economy.

Policy Objectives and Strategies

The objectives and respective strategies to be pursued through the Fund and the time dimension in which they should be achieved are as follows:

Objective A: Promotion of education to all segments of the society

To be pursued in: 2006-2008

The Fund will invest in

- Modernization of Pakistan's educational system using ICTs to improve and expand access to educational, training and research resources and facilities;

- Improve the quality of education and training and make the educational system responsive to the needs and requirements of the economy and society with specific reference to the development of the information knowledge-based economy and society
- Promote ICT skills in all schools and tertiary institutions.
- Direct special efforts at promoting the use of these technologies in rural, urban and underserved communities.
- Run a comprehensive awareness campaign to promote R&D vision and culture amongst potential participants.

It is acknowledged that the development of Pakistan's information society will depend on the level and spread of access to these technologies and their resources, services and applications within the community at large.

Objective B: To create and develop, through ICT, formal and informal learning networks for communities, with the goal of cultivating an ethos of life-long, continuous learning for individual, organizational and social advancement

To be pursued in: 2006-2008

The Fund will invest in:

- Facilitation and promotion for implementing community based ICT initiatives as well as national ICT applications with human resource development components; including multipurpose community tele-center projects; tele-education and School-Net projects; electronic government and governance initiatives.
- Programs and initiatives aimed at professional skill development in work places in public and private sector institutions, through in-service training, distance education and training and life-long learning
- Initiatives targeted at the disadvantaged sections of the Pakistani population including the visually, mentally and physically impaired and disadvantaged.
- Commit to building capacity of rural population and to encourage more participation of women and children in ICT initiatives and industry by addressing gender based inequalities

Objective C: Develop an IT-trained workforce

To be pursued in: 2006-2012

The Fund will promote

- Initiatives targeted at re-training and re-skilling of workers within the Civil and Public Service as well as workers in the private sector to provide them with requisite professional skills and expertise to enable them to fully and

effectively participate in the development of the information and knowledge economy.

- Investment will be made initiatives to improve and upgrade computer skills of workforce in both public and private sector though in-service training and skill update programs.
- Life long learning within the working population to promote on the job training ad continuing education.
- Training programs in ICTs in key industries for their workforce.
- Training of women in key skills required by information and knowledge economies.

Objective D: Creation of industry driven HRD

To be pursued in: <u>2006-2012</u>

The Fund will invest in

- Creating linkages between educational and training systems and industry thereby supporting the development of the requisite pool of highly skilled human resources, knowledge workers and expertise capable of facilitating the process of developing a technology-based knowledge driven industrial sector.
- Development of a comprehensive human resource base in critical skill areas required for a vibrant, value-added ICT services industry
- Encouraging internships and work-study programs

The Fund will ensure that training systems and mechanisms are developed to facilitate coordination and linkage between industry, academia and research institutions.

6.3.2 National Productivity Enhancement

Policy Context

The Pakistani ICT sector is underdeveloped. Majority of the companies in this sector are involved in distributive activities like retailing and the distribution of computer products and services, mainly computers and their peripherals and standard application software and packages. It is acknowledged that the development of Pakistan's information and knowledge economy will require a vibrant ICT industry that focuses on export-oriented ICT products development.

A major hindrance in the deployment and exploitation of ICTs is Pakistan's society and economy is a poorly developed and limited in coverage, communication infrastructure.
The need for Pakistan to develop a regional competitive advantage in the area of ICT exploitation and production through the development of a competitive ICT industry and services sector has been recognized. The development of the services sector into a highly competitive and value added sector has been identified as key to transforming Pakistan's economy into a high income economy with the potential to create wealth and quality jobs.

Policy Objectives and Strategies

The objectives and respective strategies to be pursued through the Fund in the field of National Productivity Enhancement are:

Objective A: Telecom and Internet Infrastructure Development

To be pursued in: <u>2006-2010</u>

The Fund will invest in

- Promoting and facilitating initiatives targeted at the development of a reliable, fast adaptive and robust national ICT backbone and infrastructure
- Ensuring that as far as possible development is not constrained by inadequate transport, communications and energy infrastructures and networks
- Modernize and expand Pakistan's information and communications infrastructure and services to improve universal access and quality of service
- Promote the development and deployment of broadband and multi-platform communications infrastructure to facilitate public access to information and services

Objective B: Indigenous Development of ICT Products and Services

To be pursued in: 2007-2012

The Fund will invest in development of local content and applications in the area of information and communication technologies to meet the needs and requirements of the nation. Development of a broad engineering base will be financed, especially in the maintenance, repair and fabrication of machinery and equipment.
The Fund will invest in development of world class software products targeting both the domestic and export market.

Objective C: Development of Advanced Information and telecommunication Networks

To be pursued in: 2008-2012

The Fund will invest in formation of the world's most advanced information and telecommunications networks. Funds will be allocated to

- Building ultra-high speed internet network providing constant Internet access the country;
- Creation of Broadband Convergence Network that will increase data transmission rate manifold and fuel the nation's growth;
- Building high-capacity and high-speed optical transmission backbone networks ;
- Upgrading Internet speed in homes; introducing new technologies including cable modem and satellite data communication will be funded.

The R&D Fund Policy envisions and integrated network linking wireless LAN, mobile telephony, broadband Internet that will bring Pakistanis closer to "anywhere, anytime" communications and computing.
The policy also targets rural connectivity and fiber wiring of commercial centers, business cluster and key industrial areas in Pakistan.

6.3.3 ICT Product Development

Policy Context

There is very little activity in Pakistan in the area of the production and development of ICT products. The majority of the ICT related companies and service providers trade in products and services with very little locally developed content. Companies retailing computer hardware import them as complete systems which they retail to public. Most of the application software (mostly standard off-the-shelf products) on the Pakistani market is also not developed locally.

This policy acknowledges that the development of Pakistan's information and knowledge economy will require a vibrant ICT industry that focuses on export-oriented ICT products development and the provision of world-class services.

Policy Objectives and Strategies

The objectives and respective strategies to be pursued through the Fund in the field of ICT product development are:

Objective A: Ensure ICT Infrastructure Support

To be pursued in: 2006-2008

The Fund will invest in

- Development of a secure broadband information and communications infrastructure to support the development and provision of world-class off-shore ICT service in the areas like software development, financial services and other ICT services targeted at the export market
- Ensuring that as far as possible, development is not constrained by inadequate transport, communications and energy infrastructures and networks

Objective B: Promote ICT Innovations

To be pursued in: 2007-2012

The Fund will invest in

- Promoting the development of a world-class software development industry targeting both the domestic and export market

- Development of local industry for the manufacture, assembling, repair and maintenance of computer and communication equipments and products
- Development of innovative local content and applications in the area of information and communications technologies to meet the needs and requirements of the nation

Objective C: Identifying and developing architectures and standards for the local ICT Market

To be pursued in: 2008-2011

The Fund will invest in Development, adoption and enforcement of international standards within ICT industry to facilitate the development of world-class and globally competitive local ICT industry and services sector

Objective D: Re-engineering the local industry

To be pursued in: 2008-2012

The Fund will invest in

- Stimulating innovation within the ICT industry and sector as a basis for promoting growth within the industry, provision of quality of services and the development of advanced and reliable communications infrastructure
- Initiatives targeted at organizational system renewal aimed at improvement on organizational structures, procedures and processes through the deployment and exploitation of ICTs
- Modernizing the banking system and promote the use of electronic banking instruments in business transactions and de-emphasize cash transactions

Objective E: Facilitating initiatives in security and privacy requirements including service provision, transaction processing and systems.

To be pursued in: 2009-2013

The Fund will invest in

- Ensuring that the development, deployment and exploitation of ICTs within the economy and society and related legal and regulatory provisions will balance and protect community and individual interests, including privacy and data protection issues.
- Creating and enacting the necessary cyber-laws including those relating to: intellectual property and copy rights; data protection and security, freedom of access to information; computer and cyber crime and other cyber-laws, necessary for facilitating their country's participation in the information age and economy.

- Support the development of the necessary legal and regulatory framework that is consistent with international and national laws, regulations, technical standards, and obligations

6.3.4 ICT Market Development

Policy Context

The Government acknowledges that ICTs can serve as the engine for developing the services sector of the economy into a competitive regional business services hub and ICT hub to provide world class ICT services, in targeted off-shore, banking and financial services to business communities in the region and beyond. The Government is committed to putting in place the necessary policy measures and provides to facilitate this process.

Policy Objectives and Strategies

The objectives and respective strategies to be pursued through the Fund in the field of ICT market development are:

Objective A: Digitization of the administration and application of IT in other public areas

To be pursued in: 2006-2010

Acknowledging the crucial role that ICTs can play in the service delivery of Government services; bringing government closer to the people, this policy makes a commitment to deploy and exploit ICTs to modernize the operations and activities of the Civil and Public Services to facilitate administrative cost reduction and the promotion of effectiveness and efficiency in the delivery of government services to the people of Pakistan. To achieve this objective, the Fund will invest in:

- Facilitating the delivery of modernized public services in the area of provision of government information and social services through the deployment and the exploitation of information and communications technologies within the society and economy
- Promote the exploitation of information and communication technologies within the civil and public services to make public services more efficient, productive and accessible to the public at large
- Implementation of relevant e-government programs and projects at the local and rural community level as a part of village information and communications infrastructure development

Objective B: Provide government services to stakeholders online

To be pursued in: 2008-2011

The Fund will invest in

- Developing and promoting standards, guidelines and procedures to facilitate the acquisition, installations and maintenance of ICT equipment and systems within Government Ministries and other Public Sector institutions and establishments
- Developing an e-government interoperability framework to facilitate cross-departmental operations of ICT systems and services
- Implementation of e-government initiatives including: government to government (G2G), government to business (G2B) and government to citizens (G2C) types of government initiatives
- Promoting the deployment and the use of ICTs to facilitate universal access to public and government information and services to support the promotion of the principle and practice of good governance
- Encouraging information sharing, transparency and accountability and facilitate the process that will lead to reduction in bureaucracy within and between organizations within the civil and public service

Objective C: Promotion of web-enabled services

To be pursued in: 2009-2013

The fund will invest in

- Locally developing web-based marketing services and data base management services including Email Marketing Campaigns, rapid response email, web surveys and search engine optimization, which contribute to generating revenue, increase customer satisfaction, and creation of a closed-loop information system for the enterprise by using integrated services and technology.
- Locally developing a range of web-enabled services including transactions processing services (order processing, claims processing and loan processing etc), financial processing services (including invoice processing, billing services etc) and HR payroll services (employee record management, payroll outsourcing etc.)

Objective D: Facilitation of E-Commerce

To be pursued in: 2010-2015

The fund will invest in

- Encouraging and facilitating the use of open electronic marketplaces, secure e-business solutions, electronic signatures, electronic public procurement and

electronic payment services to support the development of electronic commerce in the country

- Modernizing the banking system and promote the use of electronic banking instruments in business transactions and de-emphasize cash transactions
- Implementation of relevant e-government programs and projects at the local and rural community level as a part of village information and communications infrastructure development

6.3.5 Multi-Sectoral Support Program

Policy Context

This policy statement makes a commitment to establish a globally competitive, diversified and balanced economy that is driven by information, knowledge and skills ----an economy with a modern, efficient and competitive agricultural sector; an ICT-intensive biomedical research and pharmaceutical sector; and a vibrant ICT-driven, value added services sector.

The policy goal is to simultaneously focus on developing the ICT industry while at the same time using ICTs to drive other sectors of the economy. It is believed that this strategy will accelerate Pakistan's development and spread the economical impact of the development, deployment and exploitation of ICTs much faster than a singular focus of the development of the ICT sector.

Policy Objectives and Strategies

The objectives and respective strategies to be pursued through the Fund in the field of ICT market development are:

Objective A: Agriculture Sector Development via ICTs and Effective Use of ICTs in Agro-based industries in making them globally competitive
To be pursued in: 2006-2010
The Fund will invest in promoting the deployment and exploitation of ICTs to support the activities of the agriculture sector including; the production, processing, marketing and distribution of agriculture products.

- Facilitating the commercialization of the key sub-sectors of the agricultural sector an industry to improve their competitiveness
- *Developing Geographical Information Systems (GIS)* applications to monitor and support sustainable environment usage in areas like land and water management, yield assessment and livestock management
- Encouraging market research through the use of ICTs to improve access to established foreign markets and to break into new markets for both traditional and non-traditional exports
- Utilization of ICTs to link farmers and farmers' groups and associations to resources ad services that they need to improve their livelihoods through agricultural productivity, profitability and food security
- Deliverance of real time information and customized knowledge to improve farmers' decision making ability to align farm outputs with market demands, and to improve productivity

Objective B: Effective Use of ICTs in biotechnological research, pharmaceutical and health sectors

To be pursued in: 2008-2012

The Fund will invest in

- Improving research competence and promoting the application and transfer of new technologies such as biotechnology, to support improved pharmaceutical production
- Networking all healthcare institutions to collate information, share data and communication online
- Restructuring the health care system by providing a national databank to support on-line national healthcare information, administration and management at primary, regional and tertiary levels
- Promoting the use of Wireless Connectivity in Healthcare: *Using satellite technology in making high quality healthcare available to the under privileged that are separated by large distances from quality health care.*

Objective C: Using ICT for International Transactions Processing

To be pursued in: 2010-2015

The fund will invest in development of transaction processing systems with the capabilities of efficient data capture, high accuracy levels and on schedule delivery. The services in the transaction-processing segment which will be supported by the Fund, include

- *Finance/ Accounting Services:* These include Invoice processing Services, Finance Outsourcing Services, Accounts Receivables/ Payables Services and Billing Services
- *Transaction Processing:* These include Credit / Debit card applications processing, Account openings / amendments and audit checks, Claims Processing, Loans processing and Cheque processing
- *HR Payroll Services:* These include Payroll Outsourcing Services and Employee Record Management

CHAPTER SEVEN

THEMES PROPOSED FOR IMMEDIATE FUNDING

This policy has defined broad objectives within each priority area to be pursued over the 5 years of life of the policy (Chapter 6: Roadmap for Implementation) and the strategies to achieve these objectives. The specific areas that will be invested in a certain time frame will be decided by the R&D Fund Board. This process of selecting new themes will be repeated each year in which the funding priorities will be determined in the light of Policy Roadmap. The policy also defines "Themes for Immediate Funding" that will be considered by the Board while selecting themes in the initial phases of Fund's functioning. These are as follows:

1. Create awareness amongst potential stakeholders
2. Research to identify areas of comparative advantage for Pakistan
3. Research, development and support of an integrated GIS based national information platform
4. Operational support for web-enabled services
5. ICT support for textile industry
6. Provision of physical infrastructure (information technology parks) to facilitate collaboration of ICT industry and academic institutions
7. Human Resource development
    a. Support industrial training activities to decrease the cost of Telecom infrastructure deployment
    b. Implant industrial training activities in academic institutions
    c. Evolve industrial training centers implanted in academic institutions to centers of excellence.
    d. Provide needs based scholarships to students for ICT education.
    e. Foreign graduate degree programs offered in Pakistan

7.1 Create awareness amongst potential stakeholders

The success of the ICT R&D fund depends upon participation by a large segment of the potential stakeholders. This is a very large and diverse group of people. For example the stake holders include not only the traditional ICT stakeholders like academia, service providers, equipment providers but also segment of textile industry, financial industry, and agriculture to name a few. A concerted effort should be made to proactively reach out all these segments by holding industry and interest group specific seminars, workshops, advertisements etc. The effort must primarily be aimed at the most promising participants; the academic community. The effort must be made not only to give a general awareness but also training in making effective and potentially successful proposals.

7.2 Research to Identify Areas of Comparative Advantage for Pakistan

In today's global competitive environment each political entity has to find its niche. There are certain geographic, demographic, geological, climatic and other strengths each country has. On top of these natural attributes each nation has its own prevalent political, social and human development state. We need to actively fund research on identifying the areas where Pakistan has an edge in global competition. Ideally the thematic integrated approach must operate in the space identified by this research effort.

7.3 Integrated GIS Based National information platform

It is proposed that an integrated GIS based information platform be created and operationally supported by the ICT fund. This platform will contain detailed GIS information for the whole country. The quality, quantity and accuracy of the information should be such that applications like Map quest can be created for Pakistan. This information will be freely available to all.

It is expected that other value added services will be provided by commercial as well as nonprofit organizations. Some of the services envisioned are:

1. Consulting services for the agriculture sector: Various services can be provided to farmers based upon this national GIS based information platform. For example, a farmer can send images of cultivated plants periodically to receive information about pest attacks, fertilizer and irrigation needs etc.
2. Crop yield predictions: Based upon crop images received from satellites and farmers directly accurate estimates of expected crop yields can be provided.
3. Commodity price prediction systems
4. Commodity resource management systems
5. Water resource usage monitoring system

These value added services will have the following direct benefits:

1. Enhance farm productivity
2. Lead to efficient use of farm inputs like pesticides, water, fertilizers
3. Increase the demand for telecom services
4. Spread ICT activities to second tier cities in Pakistan
5. Provide human resource development in the important field of GIS
6. Stimulate research in the fields of:
    a. Cost effective video transmission
    b. Image analysis and interpretation
    c. Image based searching
    d. Automated plant disease identification
    e. Expert systems
    f. Data mining systems

7.4 Research, development and operational support for web-enabled services

Due to rapidly decreasing cost and increasing quality of telecommunications and networking services, millions of highly paid service oriented jobs are migrating from the first world to the third world. At the low end are the typical data entry, call center operator jobs and the high end jobs include financial analysts, legal advisors, technical support personal etc. These jobs add significant benefits to the economy including increase in the demand for ICT services, financial support for HRD infrastructure, induction of state of the art domain knowledge to name a few.

The competition amongst third world nations to attract these jobs is extremely cut throat. In order to exploit these opportunities we need the following enabling environment:

i. An efficient and cost competitive ICT infrastructure
ii. Highly skilled manpower for each of the domains like financial services, legal services, etc.
iii. Automated ICT systems to achieve efficiency
iv. Legal infrastructure to protect information

The research fund should directly support ICT related research and development activities. In order to impart communication skill, English language fluency, domain specific skills coordination with ministry of education should be achieved. The following research and development areas should be supported:

i. Distributed and grid based computing
ii. Integration technologies for BPO
iii. Decision support systems

iv. Intelligent voice communication systems
v. Open source initiatives

7.5 ICT support for textile industry

Approximately 75% of exports from Pakistan are related to production of cotton and value added products from textile industry. A thorough study of ICT needs of the whole textile industry value chain should be performed. The study should evaluate the current usage of ICT in Pakistan in each of the segments. This usage level should be compared with the use of ICT in textile industry internationally. Opportunities for improving the productivity of textile industry by more effective use of ICT should be identified and project should be initiated to avail these opportunities. This effort should be complemented by ICT research and development in Pakistan to produce software and systems to be used by the textile industry.

7.6 Provision of physical infrastructure (information technology parks) to facilitate collocation of ICT industry and academic institutions

The ICT industry is experiencing a significant rise in outsourcing of research and development activities to the 3rd world. Pakistan should position its self to receive a significant share of this out sourced research and development activities. We need to provide information technology parks at a subsidized cost to help make Pakistan an attractive destination for these jobs. Our academic institutions are facing a significant shortage of faculty with industrial experience. Similarly our industry needs a large number of senior technical experts. We also need to enhance the industry academia cooperation. It would be very useful to establish these new information technology parks physically near our academic institutions so that critically short resources can be effectively shared between industry and academia. This collocation is likely to lead to a fusion of ideas generated by academia and industry.

7.7 Focused Human Resource Development

7.7.1 Support industrial training activities to decrease the cost of Telecom infrastructure deployment

Pakistan is going through the phase of rapid deployment of telecommunications infrastructure. Service providers need skilled manpower that can perform the deployment efficiently at a low cost. Several equipment vendors have in house training programs. It would be very useful to use this R&D fund to increase this manpower training capacity so that we can reduce the cost of infrastructure deployment in Pakistan. In near future this trained manpower can be used to make Pakistan a center for regional consulting services.

7.7.2 Implant industrial training activities in academic institutions

In near future we should integrate these industrial practical training programs into our technical education. Funds should be provided to house well equipped laboratories and well trained technical staff in our public as well as private academic institutions. As these laboratory facilities are created we can house the above mentioned industrial practical training programs in our academic institutions on a more permanent basis.

7.7.3 Evolve industrial training centers implanted in academic institutions to centers of excellence.

Centers of technical excellence should be used to create research and development culture in our academic institutions. There are several important factors that should be considered before these centers are funded. These centers of excellence should be integrated with the current economic activities and technical know how in the country. These centers of excellence should be able to sustain their activities financially after initial funding provided by the ICT R&D fund. A very effective vehicle for achieving these goals could be to let the industrial training programs to evolve into centers of excellence. Since these centers of excellence will evolve from industrial training programs there is a good possibility for these centers to become economically self sustaining and be relevant to local industry needs.

7.7.4 Provide needs based scholarships to students for ICT education.

At present private educational institutions are providing higher quality ICT education in Pakistan than the quality of education in most of the public sector universities. There is a dire need to improve the quality of education in our public universities. However, this is a challenging and a longer term initiative. In the short and medium term time scale the ICT R&D fund should provide needs based scholarships so that talented students fro economically challenged classes can get this quality education. These scholarships will go a long way towards providing upward mobility for economically challenged citizens of Pakistan.

7.7.5 Foreign graduate degree programs offered in Pakistan

Higher education commission (HEC) has appropriated a large sum of funds to give scholarships to Pakistani students for higher education in universities in the 1st world. This is a very needed yet a very expensive proposition. There is a worldwide trend to house prestigious 1st world academic programs in 3rd world institutions. We should seriously consider financing efforts to bring some of these programs to Pakistan. This

effort will reduce the cost of these scholarships and help improve our local graduate programs as well.

CHAPTER EIGHT

PROCESSES TO ACHIEVE POLICY OBJECTIVES

The policy document sets priorities for implementation from short to long term. However in the face of rapid technological changes, new technologies may emerge and old technologies become obsolete in a very short space of time. This whole spectrum of uncertainty about the future preferences in the ICT sector urges the need to have an ecosystem that could align the policy roadmap accordingly. The shift in priorities, change in direction, recognition of new technologies and obsolescence could only be catered through an interrelated chain of processes. This policy recognizes that chain to be as follows:

1. Process to determine themes/areas for the R&D initiatives that would be industry driven
    - The proposed initiatives are thematic and non-thematic
    - Within the thematic initiatives, we will have short term, medium term and long term initiatives
2. Process to solicit proposals for R&D projects
3. Process to evaluate submitted proposals
4. Processes to allocate relative funds to R&D projects
5. Process to monitor funded projects
6. Process to make results of R&D projects available to stake holders

The process system will form a continuous cycle and the core objective is to create an environment that would have a proactive check on the policy direction in the face of diffusion of changing technology and business practices.

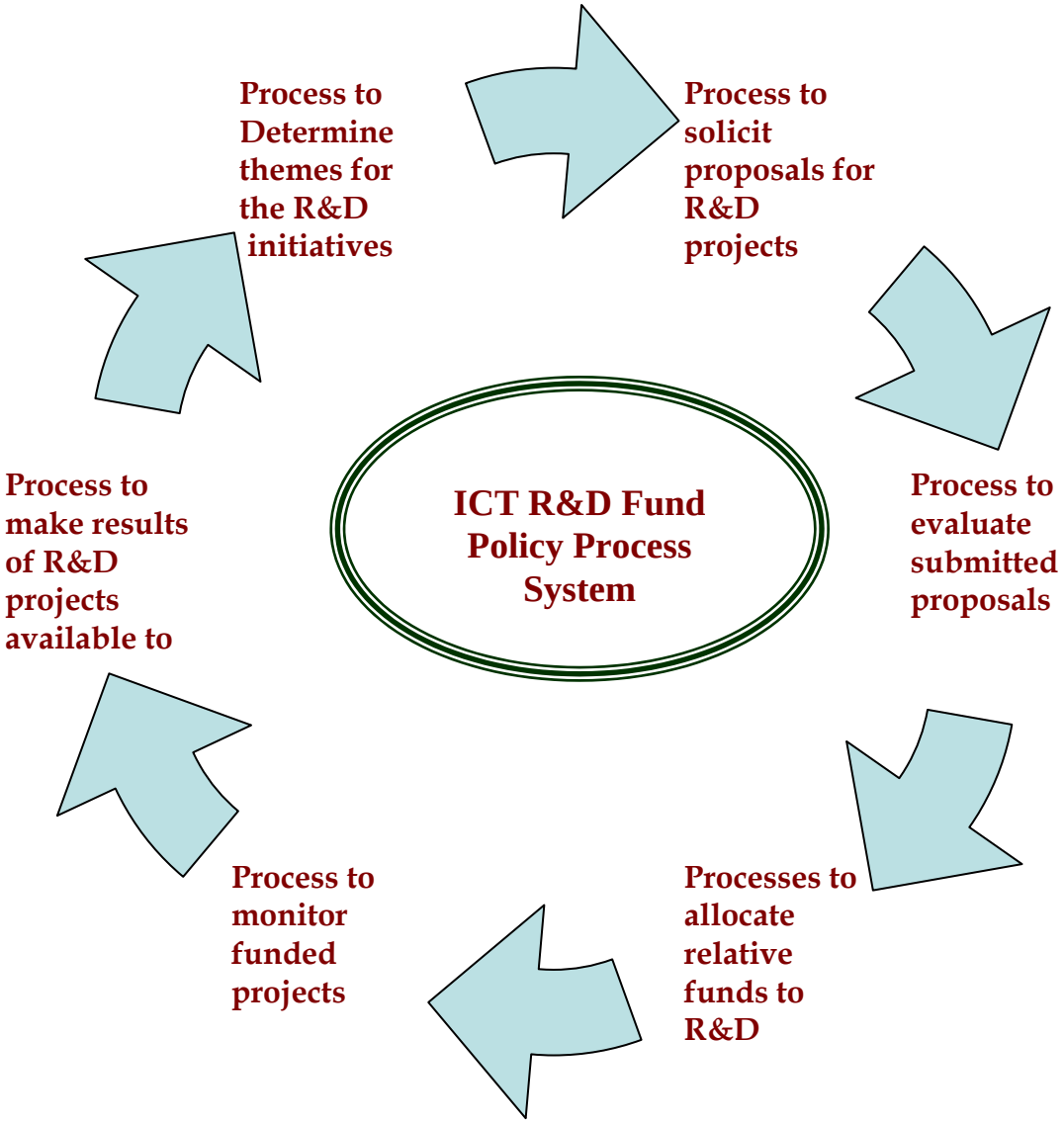


Figure 3: Processes to Achieve Policy Objectives

8.1 Sub Process 1: Theme Selection

This policy has defined broad objectives within each priority area to be pursued over the 5-10 years of life of the policy (Chapter 6 of Policy Document) and the strategies to achieve these objectives. The specific areas that will be invested in a certain time frame will however be decided by the R&D Fund Board. This process will be repeated each year. The Board will have quarterly meetings in which the performance of projects funded in previous period will be reviewed. Since R&D projects are generally long term projects, funding for most of the projects will continue beyond 1 year.

The members of the Board shall include representation from industry, academia and government. A detailed structure of the Board is discussed in "Legal, Administrative and Financial Structure" for R&D Fund. Members shall identify themes to be funded for achieving the specific objectives outlined in policy roadmap. The areas selected for investment may consist of both thematic and non-thematic categories. Priority will be given to thematic areas that represent the creation of a complete value chain. The value-chain must encompass the emerging knowledge revolution and a market-driven demand process.

In the process of theme selection, the Board shall refer to the Areas Identified for Immediate Funding in chapter 7 of this policy document in addition to referring to the policy roadmap in chapter 6. In the initial phase of its functioning, the Fund will allocate the major portion of its resources in Human Resource Development. Second Priority will be given to National Productivity Enhancement via infrastructure development and identification of comparative advantage and capitalizing on this advantage through development in indigenous industry. Simultaneously, investment will also be made in ICT Product and Market Development and Multi-Sectoral Development via ICT proliferation, however, initially a very small portion of the funds will be dedicated to these areas. In later phases of operation, when R&D Fund has successfully laid strong foundations of human resource for ICT and has caused sufficient exhaustion of the existing comparative advantage, more funding will be allocated to areas of product and market development in ICT sector.

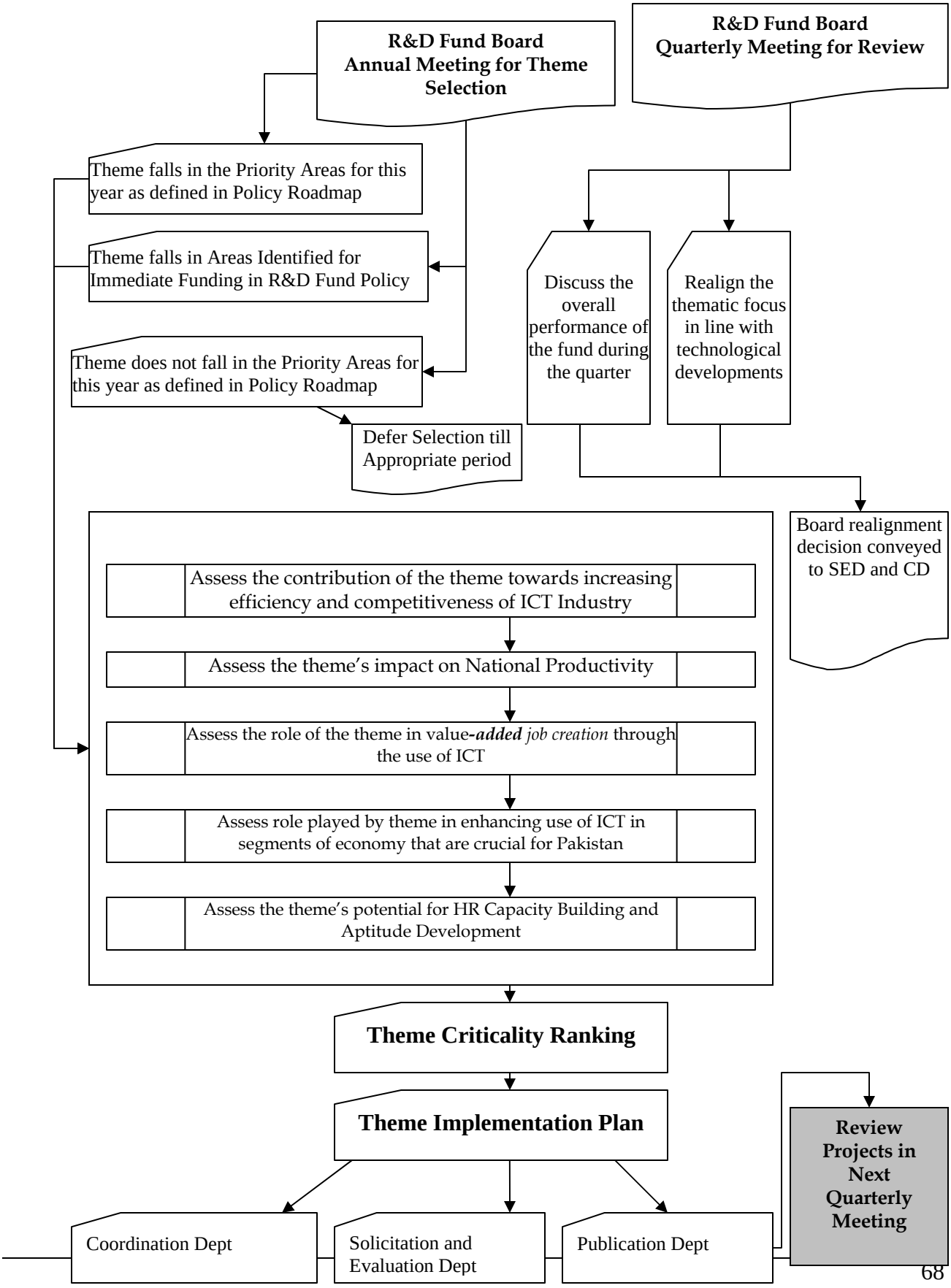
While selecting the themes for investment, they may be evaluated against the following objectives:

- Does investment in this theme lead to improving the efficiency and competitiveness of ICT Industry?
- Does this value chain or project have potential for increasing the demand for ICT Services?
- How will it impact the national productivity?
- Does this theme or value chain promote enhanced use of ICT in segments of economy that are crucial for Pakistan?

- Will investment in this theme lead to ***value-added*** *job creation* through the use of ICT?

This policy allows the Principal Investigator or PI (the main researcher who submits proposal) while operating within the established policies of the R&D Fund to pursuer interesting and important leads that may arise during the conduct of a research project or to adopt an alternative approach which appears to be a more promising means of achieving the objectives of the project. Significant changes in methods or procedures for medium to large scale projects may be reported to Project Appraisal Committee (PAC), which shall consist of three Board members. The PAC will then reviews and take necessary action in this regard. For additional funding requirements, PAC will forward the renewed project to Fund Allocation Department. If not approved, then the PI will have to adhere to the methodology earlier agreed upon. If the PI does not agree, then the cancellation procedure for the project should be initiated.

Flow Chart 1: Process to Select Areas for Funding



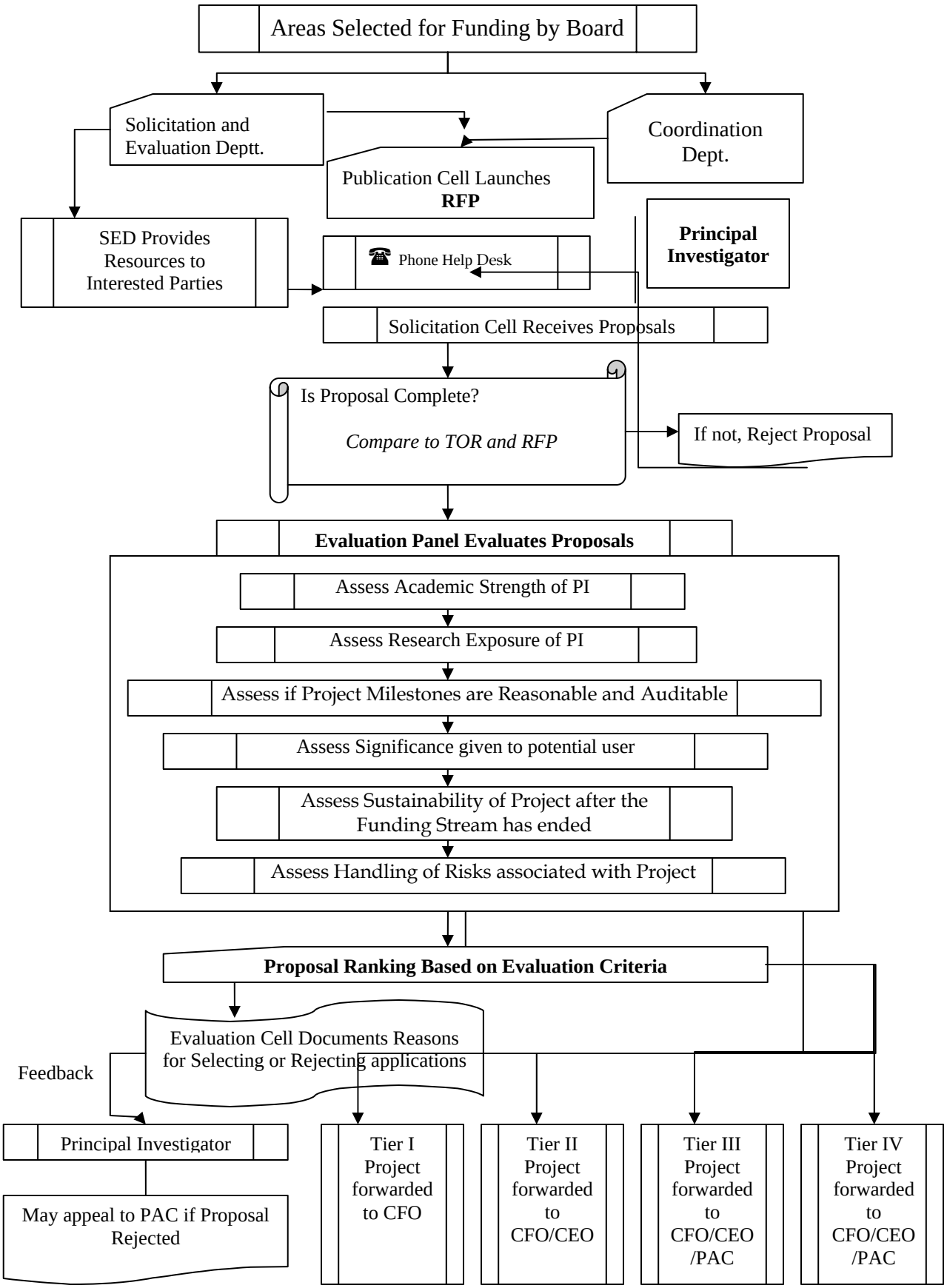
8.2 Sub Process 2: Proposal Solicitation

Once the themes have been identified; the Board will initiate the implementation process through the R&D Fund organizational bodies. A Request for Proposals (RFP) will be launched by the Publication Department inviting industry and relevant parties to submit proposals for projects on the selected themes. The Proposal Solicitation and Evaluation Department will coordinate with the Publication Department in creating appropriate advertisements, as described in Operations Manual of R&D Fund. A Coordination Department will also assist in this regard. It is important that the Fund allows ample time for bidders to prepare their proposals, as mentioned in the Operations Manual. It should also be taken into consideration that a foreign bidder may need additional time than would a national entity. The evaluation criteria will be clearly detailed in the RFP.

The next important step after RFP is of providing resources to the principal investigators. The Solicitation and Evaluation Department will be responsible for this activity. Resource kit including proposal submission forms and guidelines will be provided to the interested parties. The guidelines should be self-explanatory to create uniform understanding of the procedures among bidders. In addition, a Phone Helpdesk will be made available for briefing the principal investigator on related issues.

In the third step, proposals will be received. The proposal must contain the agency's proposed technical solution, management approach, cost and technical evaluation summary as mentioned in the Operations Manual. Proposals usually contain very sensitive, and often confidential, commercial information. It is important that proposals be treated carefully by the solicitation Department to ensure that this sensitive information is not released to outsiders.

Flow Chart 2: Proposal Solicitation and Evaluation



8.3 Sub Process 3: Proposal Evaluation

8.3.1 Evaluation Panel

A panel will be created by the Proposal Solicitation and Evaluation Department of the R&D Fund, the size of which will reflect the scale of the activity to be funded. Depending on the scale of the program, a number of experts in the community and/or members from other committees and relevant external organizations may also be invited to participate in the evaluation process to ensure an appropriate skills mix. The evaluation will be initially done internally and then referred to external panel not exceeding three members. The panel will be approved by the Board.

8.3.2 Conflicts of Interest

Members of the Evaluation Department and other experts can be involved in the evaluation process for relatively large scale calls if their host institution is submitting a proposal. However, all conflicts of interest must be declared by evaluators at an early stage.

Once internal evaluation indicates the feasibility, bids would then be verified by external evaluators. All bids will be marked by at least two evaluators and by three evaluators in most cases. Where a bid is only marked by two evaluators and there is a discrepancy in the marks, a third evaluator will be invited to mark the relevant bid, this process in detail is described in the Operations Manual.

8.3.3 Evaluation Criteria

A standard mark-sheet and guidance for markers is drawn for each evaluation process, the format of the marks-sheet is given in the Operations Manual. This is to help in ensuring a common approach from evaluators and to clarify the evaluation criteria as prescribed by the Operations Manual, and definitions for the different marks it is possible to award. There are a number of sections which require detailed comments from markers to clarify the mark awarded for each criterion and to describe overall impressions of the bid and a recommendation.

The evaluation criteria will be clearly detailed in any invitation to tender or call for proposals. Criteria will only be weighted at the evaluation stage if explicitly stated in the invitation. The evaluation criteria and weights are used as a basis for deciding and documenting the ultimate decision.

Below are the highlights of the Evaluation Process, explained in detail in the Operations Manual.

- The Evaluation Panel must each sign a declaration indicating that they accept the code of conduct which involves matters of ethics, conflict of interest, confidentiality and non-disclosure

- Mark each proposal based on the Evaluation Criteria

- Evaluation panel members are careful to preserve equity between tenders and to fully understand and document the reasons for selecting and rejecting bids, and any caveats attached to funding awards.

- In addition to demonstrations of heritage and public benefits, ICT projects will need to provide evidence that they have actively been designed to reduce risks. In considering whether or not to fund an ICT project the Evaluation Department should investigate at least the following aspects of the proposed applications:

    - How does the project fit with the institution's own strategy and policy?

    - Has the team looked at the potential user(s)?

    - Have the user needs been thought out?

    - Has maintenance been included?

    - If the project involves digitization, is the core resource that is to be digitized in a good enough state to permit its digitization?

    - If the project involves automation, is the approach merely cloning a manual process with automation or is it using automation to improve practices?

    - Is the project sustainable after the funding stream has come to an end?

    - Has the project planning involved making the risks associated with the project manageable?

    - What is the output of the application of the risk assessment model?

- Are the project milestones reasonable and auditable?

- Analysis of Marks

  - Once bids have been evaluated and mark-sheets returned, the GM Evaluation and Solicitation prepares an analysis of marks and provides a table of markers comments. The analysis is also reviewed to look for inconsistencies in marking or any irregularities or errors. The analysis is then circulated to the evaluation panel via email

- Panel Meeting

  - For relatively large bidding exercises, the evaluation panel often finds there is also a need to physically meet to discuss the outcomes of the initial marking process and to finalize recommendations for the principal investigator (PI). Depending on the scale of the program, this meeting can often take better part of a day. Members with conflicts of interest, if any, must leave the room when their bid is being discussed. The GM Solicitation and Evaluation will prepare a formal record of the discussions and decisions taken at the meeting

  - A physical meeting is not usually necessary for limited tender exercises where a single activity is being procured. The panel is simply invited via email to endorse the recommendations made by the GM Solicitation and Evaluation based on the outcomes of the analysis of marks and comments. However, if there is a divergence of views from marker, a meeting may prove necessary.

  - For both mutually exclusive as well as independent projects, the evaluation panel will give preference to thematic projects, i.e. those projects which form a part of larger value chain.

  - If the proposal is rejected by the evaluation panel, the principal investigator reserves the right to appeal to a Project Appraisal Committee or the CEO (as explained in the Operations Manual) for reconsideration. The decision of PAC will be final.

- If the proposal is approved, the evaluation Department will forward its Evaluation Report to the Finance Department.

8.4 Sub Process 4: Process to allocate relative funds to R&D initiative categories

Relative funding criteria for each thematic category may be defined right after the definition of process 1(ref. to 8.1); however that must not be treated as a structured budget but rather a flexible guideline as to where the funds should be spent.

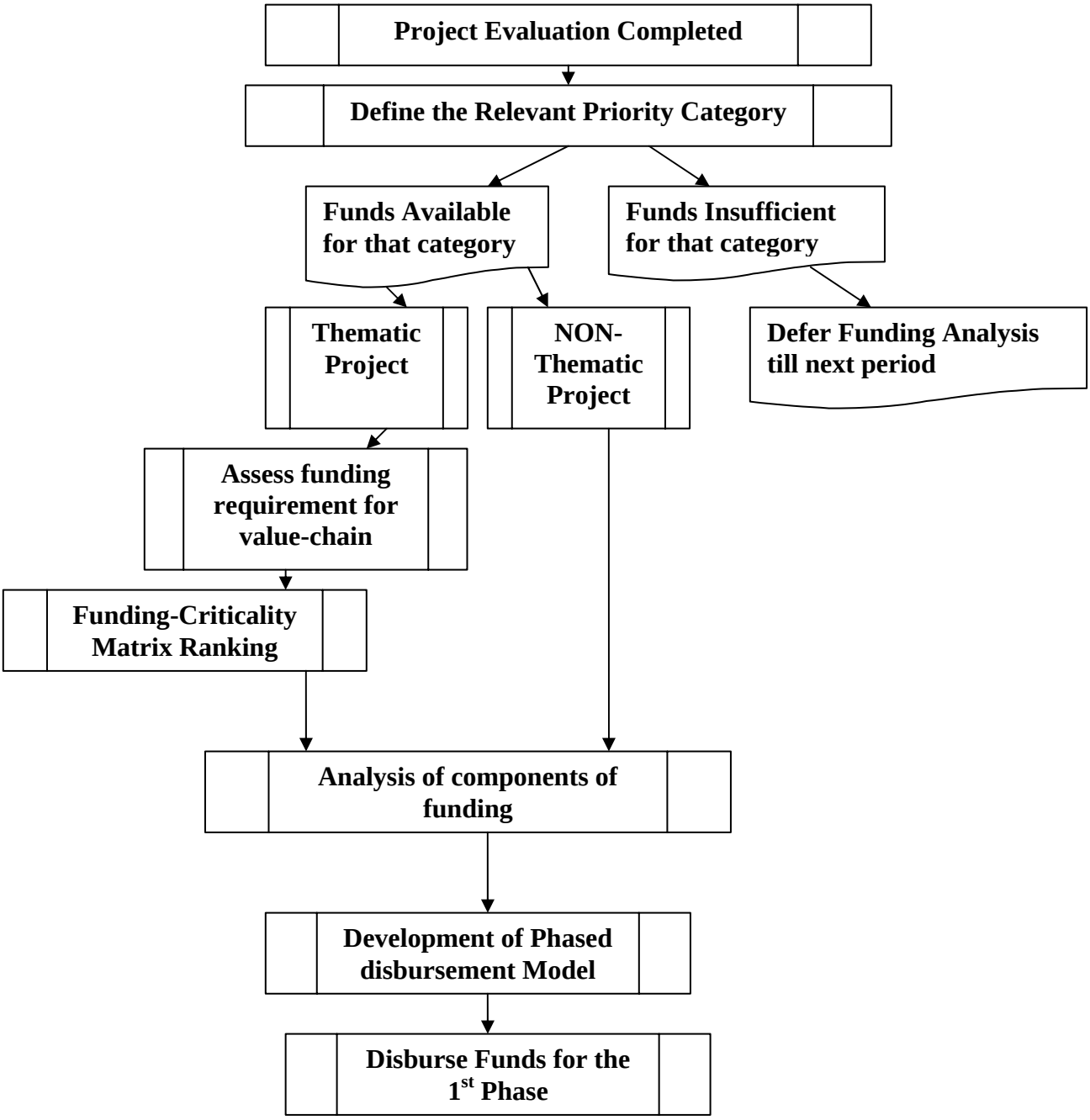
The Finance Department will study the project evaluation report prepared by the Solicitation and Evaluation Department. It will then proceed with the funding procedure which will follow the following steps:

- For projects that fall within Thematic Categories: Identify the whole value chain
- Identify what links of that value chain need to be supported by ICT
- Determine a time line for complete value chain completion through R&D to achieve optimal results
- Share with the industry/academia through the R&D board, the untapped links of the value chain and assess their willingness to contribute resources for those particular links
- Assess the funding available for indirect links by complementary funding agencies and their willingness to contribute those funds within a reasonable frame of time
- Communicate with other funding agencies the proposed time line for the completion of the whole value chain
- Establish priority of the evaluated project within the whole value chain
- Estimate the total funding needed to support the whole value chain and the funding required by the project as a fraction of total funding requirement and relate it to its relative importance
- Rank all projects on the basis of following criteria in a chronological order
  - Criticality of the value chain (instead of the project)

  - Relative significance of a given project with relation to the value chain
  - Commercialization Potential of the project and the value chain development

- Assess the funding requirement along the following guidelines
  - Sensitivity margins w.r.t. Key indicators and key inputs
  - The breakdown between direct and indirect expenditures
  - Analysis of phased expenditures alongside the suggested time-line and disbursement schedule to support the phased development
- For non-thematic approach, all the above will be applicable except for any assessment regarding the value chain
- Assign funds to the projects

Flowchart 3: The work flow for the process would be as follows:



Flow Chart 3: Process to allocate relative funds to R&D initiative categories

8.5 Sub Process 5: Process to monitor funded projects

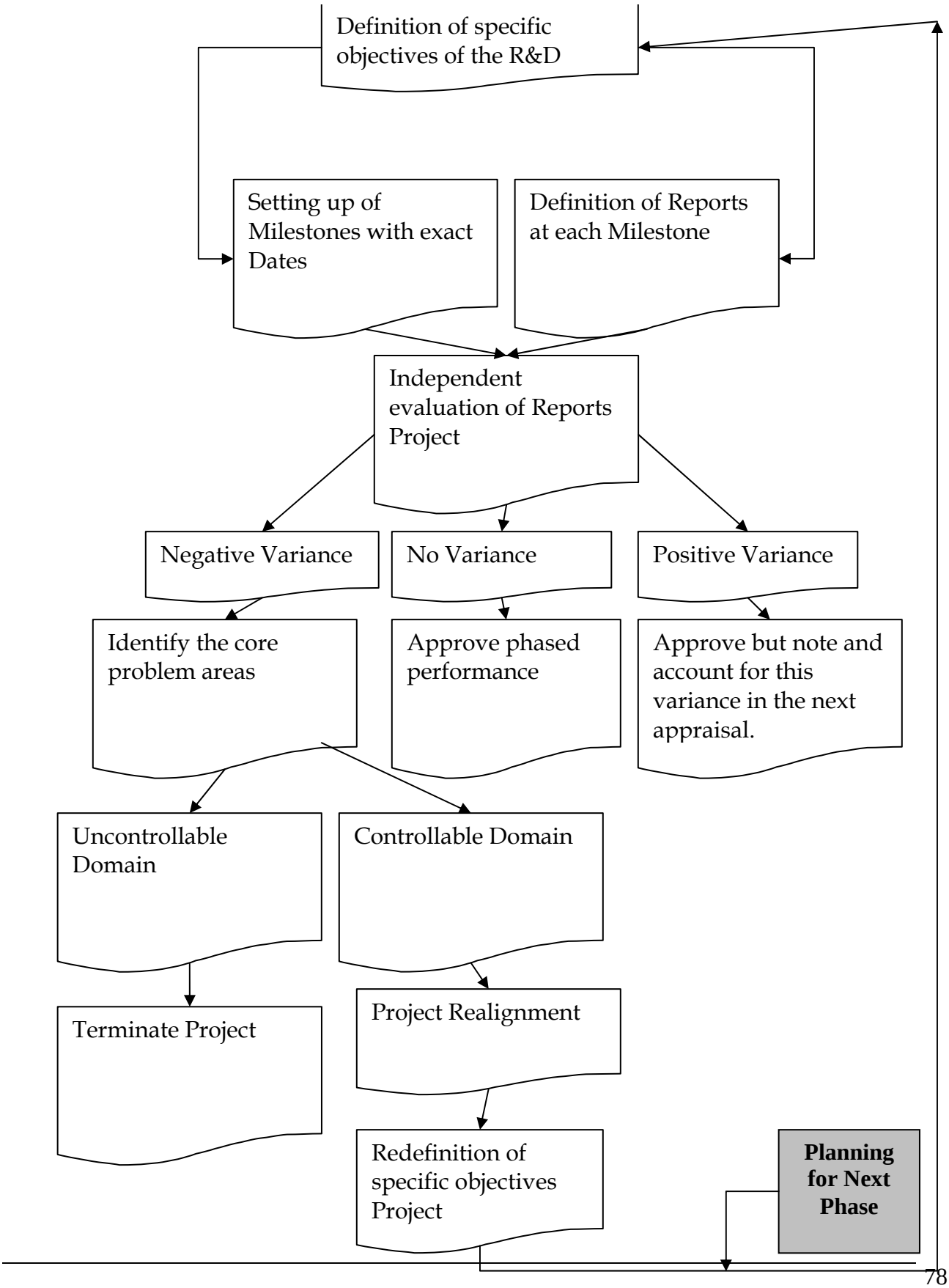
Effective monitoring of the project progress would be the key factor in the whole process because that is where the control of the funds has shifted from the Fund to the principal investigator. The difference between success and failure would be the prudent utilization of those funds to meet the specified objectives. As described in the historical perspective, monitoring has traditionally been the weak components of all R&D initiatives taken in Pakistan; therefore the policy stresses the maximum emphasis on development of a proactive effective monitoring model.

The model will revolve around these basic components:

- Definition of specific objectives for the R&D Project
- Setting up Milestones and Specific Reports
- Appointment of an independent monitoring team
- Appraisal at the given milestone
- Measurement of the variance
- Corrective action in case of negative variance

The process flow is mentioned on the next page:

Flow Chart 4: Process to Monitor Funded Projects



The key to the success of the monitoring process depends on the appraisal, that must be in line with what specific objectives the project was aimed at and to what extent those projects must be accomplished at the first milestone. That requires a clear description of goals and strategic focus of the project. It is imperative that every project must be divided into phases and disbursement of funds must be relative to the completion of each phase.

The next most important criterion is to determine, when there is a negative variance, whether the project progress can be fixed or not. If the project is deteriorated to a point where it is beyond the control of stakeholders to fix it then the project must be terminated.

The other possibility in case of negative variance would be an impairment that is manageable. That requires the identification of key problem areas and realignment of the project. The realignment will then change the objective set or milestones and that must be incorporated in the second phase of appraisal.

Some of the most common reasons for the troubled projects are summarized as follows:

Reason	Example	Type	Action
Project not aligned with Value Chain	No real affect on other concurrent value chain activities is identifiable	Structural	Verify Alignment before project Kicks off
Lack of support by one or more of the project team	Insufficient Funding or resources; Industry Academia Conflict; Vague Objectives	Integrated	Clarify Project Details, Clarify Project Impact, Review Funding, Gain Acceptance, Improve Communication
Sluggish performance of team members	Inactive Unengaged sponsor, Ethical Issues, Not supportive of project management processes	Integrated	Educate the sponsor on role and responsibilities, Understand Team players motive and incentives, redefine the incentive structure
Lack of clarity on Responsibilities	Missing Deadlines, Lower team morale, Delayed Issues resolution	Integrated	Use of responsibility Matrix, review of roles, Validate expectation
Poor Communication	Inconsistent and incomplete	Internal	Develop Project

amongst the team members	information on project metrics, Poor feedback from stakeholders, repetition of messages		Communication plan, Clearly set context of each feedback and messages
Resource Conflict	Lack of dedicated Team members, Key resources not available when scheduled	Structural	Redefine Project resource Plan, Involve Additional stakeholders if required
Unforeseen Technical Difficulties	Effort spent on resolving technical issues make team miss deadlines, Unproven technology does not meet expectations	Structural	Structure project to deal with high risk technical challenges early on the project Prove the technology before making additional investment

The whole process would be to adopt a proactive approach by identifying all the possible problem areas and having a contingent plan ready to meet any unforeseen activity during the life of the project. For this very purpose the head of the Monitoring Department should effectively act as project manager and must be equipped with following tools at all times.

Tool	Description	Value	Notes
Project Approval Plan	Authority and role of Monitoring Department	Provide official charter and scope of authority	May be modified after each appraisal
Project Definition Document	Define Project Vision, objective, success criteria and scope statement	Key for managing expectation and controlling scope	Core Tool
Requirement Document	Defines the specifications of the product/output of the project	Key for managing expectation and controlling scope	Core Tool
Project Schedule	Shows all logical interdependencies and define resource schedule against a calendar	Key for directing all project work efforts, Allows for impact and what-if simulations	Core Tool

Status Reports	Periodic Review of actual performance against expected performance	For identifying variance patterns and for information to key stakeholders	Careful evaluation of negative and positive trends
Milestone Chart	Summary of key indicators progress against a calendar	Information to stakeholders about the progress	Can be very complex and diffusing from one period to the other
Responsibility Matrix	Define all project roles and respective responsibilities for each role	Establishes accountability	For small project, combine with project definition document
Communication Plan	Define , what, how, when and who of information flow to stakeholders	Establish Stakeholders confidence	For small project, combine with project definition document
Change Request Form	Capture any essential change that would affect scope of the project	Allows change items to be properly assessed	Core Tool
Project notebook	Kept by the Evaluation committee head for official record of documents and key deliverables	Key for measurement of progress	Both Hardcopy and soft Versions should be kept

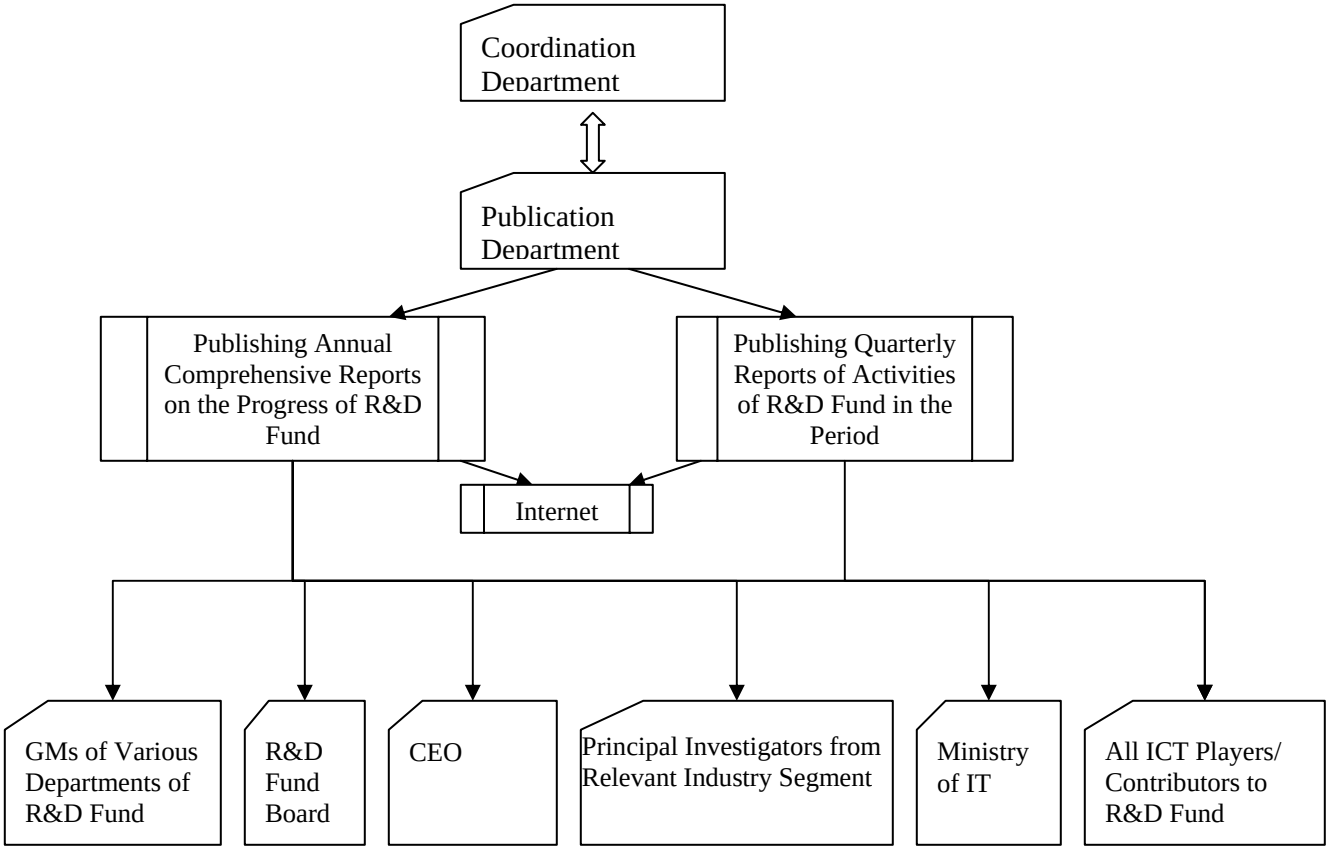
8.6 Sub Process 6: Process to make results of R&D projects available to stake holders

This sub-process is relatively simpler compare to the other components of the system. The requirement for effective delivery of this process include effective liaison between the Monitoring Department, the Publication Department, CEO, and the Board. A report will be published each quarter covering all the activities of the R&D fund in the period. At the end of each year a comprehensive report will also published to keep stakeholders informed about the progress of the R&D fund. The reports must also be available on internet.

The report amongst other must contain the following information

1) Total number of R&D projects initiated during the period
   a) Classification by Category
   b) Classification by value-chain
   c) Classification by Sponsor/ Stakeholder
2) Total number of projects completed and delivered during the period
   a) Classification by Category
   b) Classification by value-chain
   c) Classification by Sponsor/ Stakeholder
3) Individuals comparisons of Projects with the milestone schedule
   a) Comparative figures for the various projects from the corresponding periods
4) Total Funding provided during the period
   a) Funding made available for new project
   b) Phased Funding for existing Projects
5) Details of financial contribution (if any) by the stakeholders
   a) Funding classification according to defined categories
   b) Comparisons with budgeted figures at the beginning of the period
6) Project Results
   a) Success/ Failure Ratio
   b) Commercialization of output/product
7) Investment by Category and impact assessment
   a) Investment by industry segment and impact assessment
8) Future Projections
   a) Budgeted figures for each category for the next three quarters
   b) Targets for the next three quarters
9) Summary of variance analysis for the past targets and budgets

Flow Chart 5: Process to make results of R&D projects available to stake holders



CHAPTER NINE
CONCLUSION

This policy document makes an attempt to draft the priorities and processes of the National R&D Fund in such a way that this new endeavor improves upon the previous research experiences in Pakistan and also takes into account international best practices of the present era. The policy defines the following vision to be achieved via implementation of various strategies defined by it:

To transform Pakistan into a knowledge based economy by promoting efficient, sustainable and effective ICT initiatives through synergic development of industrial and academic resources

It is acknowledged that in the new information age, the mere use of information, knowledge and technology can improve the socio-economic development fortunes of a given nation. However, evidence shows that those nations, who in addition, are involved in the development as well as in the selling of information (and information products), knowledge (and knowledge products) and technology (and its products), are moving faster on the socio-economic development scale compared to others. There is no doubt that in the new emerging economic order, the fundamental basis for wealth creation and national prosperity are information and knowledge, and that, Pakistan cannot afford to be without either of these.

The policy regards following four steps as catalysts that would enable the policy to achieve above mentioned vision: Enabling Government directives comprising of the supportive policies; Creation of a Legal System or regulatory framework that supports a

globally connected knowledge based economy; Creation of a well trained and efficient young manpower and efficient and cost effective infrastructure.

In order to attain its vision of making Pakistan a knowledge-based economy and society, this policy lays down five key areas for investment; these are: HR Capacity Building, National Productivity Enhancement, ICT Product Development, ICT Market Development and Multi-Sectoral Support. For each of these areas, broad objectives and strategies have been defined in the policy to be achieved in certain time frames. The policy has an operational life time of 5 years. It is mandatory upon the Board to devise a new policy at the end of 5 years of its operation. However, funding may be continued in key areas, if it is considered appropriate by Board members. This policy also highlights the possible areas which may form part of the revised policy. The policy recommends continued investment in these areas after policy revision for achievement of its vision.

The policy also describes the necessary processes to be enacted by the National R&D Fund during its functioning. These are:

Process to determine themes/areas for the R&D initiatives

Priority will be given to those projects that form a part of a complete value chain that is driven by the industry, over projects that are developed in isolation

Process to solicit proposals for R&D projects

This process involves a request for proposals for selected themes and areas and provision of resources to the interested parties

Process to evaluate submitted proposals

The evaluation criteria for submitted proposals include: the significance given to potential user, if the maintenance issue was addressed, whether the project is sustainable after the funding stream has come to an end, how the risks associated with project have been

addressed and whether the project's milestones reasonable and auditable. These criteria have been described in detail in Operations Manual for the National R&D Fund.

Process to allocate relative funds to R&D projects

All projects will be rank for allocation of funds on the basis of following criteria: criticality of the value chain (instead of the project for thematic areas), relative significance of a given project with relation to the value chain, commercialization Potential of the project and the value chain development.

Process to monitor funded projects

Monitoring has traditionally been the weak components of all R&D initiatives taken in Pakistan; therefore the policy stresses the maximum emphasis on development of a proactive effective monitoring model. The model will revolve around these basic components: Definition of specific objectives for the R&D Project, Setting up Milestones and Specific Reports, Appointment of an independent monitoring team, Appraisal at the given milestone, Measurement of the variance and Corrective action in case of negative variance

Process to make results of R&D projects available to stake holders.

Quarterly and annual reports will be published to keep the stakeholders informed about the progress of the fund. This process system will form a continuous cycle and has been designed so as to create an environment that would have a proactive check on the policy direction in the face of diffusion of changing technology and business practices.

With the National R&D Fund scheduled to start operating in year 2006, Pakistan will make a major move towards significant participation in the global information revolution. This policy framework will enable the R&D Fund to tap on key areas necessary for advancing Pakistan's position in global ICT players.